

SOP for Chemicals (S to Z)

Sand
SBA-15
Sebacic acid
Silica gel
Silicon dioxide
Silicon oil
Silver nitrate
Sodium
Sodium borohydride
Sodium bromide
Sodium chloride
Sodium citrate tribasic dihydrate
Sodium hydroxide
Sodium hypochlorite solution
Sodium iodate
Sodium mesoxalate monohydrate
Sodium metatitanate
Sodium nitrate
Sodium nitrite
Sodium silicate solution
Sodium sulfate
Sr precursor [Strontium 2,4,5-tri-*tert*-butylimidazole]
Succinic acid
Sulfuric acid
Sulfuryl chloride
Tartronic acid
tert-Butanol
tert-Butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine
tert-Butylhydroperoxide solution
Tetraamineplatinum chloride hydrate
Tetradecyltrimethylammonium bromide
Tetraethyl orthosilicate
Tetrahydrofuran
Tetrakis(dimethylamino)titanium
Tetrakis(hydroxymethyl)phosphonium chloride solution
Tetramethyl orthosilicate
Tetraoctylammonium bromide
Titanium butoxide
Titanium dioxide

Toluene
Toluene- d_8
trans-2-Butene
trans-4-Hydroxy-L-proline
trans-Chalcone
Trichloroethylene
Triisobutylaluminum
Trimethylaluminum
Trimethyl(methylcyclopentadienyl)platinum
Tris(2,2,6,6-tetramethyl-3,5-heptanedionato)ruthenium, [Ru precursor]
Uridine-5'-monophosphate-disodium salt
Zinc oxide

Sand

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sand (SiO₂, CAS No. 238-878-4) is used in laboratory. Its purpose is not to have any accident or risk. Sand causes skin and eye irritation. It may be harmful if inhaled or if swallowed. The sand bottles in room 143 is for safety of pyrophoric chemicals (trimethylaluminum).

Synonyms: Silicon dioxide, Quartz

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Target Organ Effect (Lungs), Irritant

GHS Classification

Acute toxicity, Oral (Category 5)

Specific target organ toxicity – repeated exposure (Category 2)

Signs and Symptoms of Exposure

Prolonged inhalation of crystalline silica may result in silicosis, a disabling pulmonary fibrosis characterized by fibrotic changes and miliary nodules in the lungs, a dry cough, shortness of breath, emphysema, decreased chest expansion, and increased susceptibility to tuberculosis. In advanced stages, loss of appetite, pleuritic pain, and total incapacity to work. Advanced silicosis may result in death due to cardiac failure or destruction of lung tissue. Crystalline silica is classified as group 1 "known to be carcinogenic to humans" by IARC and "sufficient evidence" of carcinogenicity by the NTP. The chronic health risks are associated with respirable particles of 3-4 um over protracted periods of time. Currently, there is a limited understanding of the mechanisms of quartz toxicity, including its mechanisms for lung carcinogenicity. Additional studies are needed to determine whether the cell transforming activity of quartz is related to its carcinogenic potential.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Respiratory Protection

For nuisance exposures use type P95 (US) particle respirator. For higher level protection use type OV/AGP99 (US) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US).

b. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

c. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

d. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Gloves must be inspected prior to use. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sand must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sand.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sand must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sand and understand the hazards.

Lab workers using sand must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sand described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines factors) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this sand in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sand with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sand. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Working with Pyrophoric chemicals

1. Wear flame-resistant glove outer, chemical-resistant inner gloves, flame-resistant lab coat, and safety goggle.
2. Working with trimethylaluminum is not allowed when alone in the lab.
3. Prior to starting the reaction, locate this dry sand, fire extinguisher, eyewash and safety shower.
4. Wear proper FR PPEs according to SOP of trimethylaluminum or pyrophoric chemicals.
5. Follow the instruction in SOPs of pyrophoric chemicals.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 07/01/2014, 03/01/2016

SBA-15

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when SBA-15 (SiO₂, CAS No. 7613-86-9) is used in laboratory. Its purpose is not to have any accident or risk. SBA-15 causes skin and eye irritation. It may be harmful if inhaled or if swallowed.

Synonyms: Mesoporous Silica

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Target Organ Effect (Lungs), Irritant
GHS Classification

Acute toxicity, Oral (Category 5)

Eye irritation (Category 2A)

Specific target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

Prolonged inhalation of crystalline silica may result in silicosis, a disabling pulmonary fibrosis characterized by fibrotic changes and military nodules in the lungs, a dry cough, shortness of breath, emphysema, decreased chest expansion, and increased susceptibility to tuberculosis. In advanced stages, loss of appetite, pleuritic pain, and total incapacity to work. Advanced silicosis may result in death due to cardiac failure or destruction of lung tissue. Crystalline silica is classified as group 1 "known to be carcinogenic to humans" by IARC and "sufficient evidence" of carcinogenicity by the NTP. The chronic health risks are associated with respirable particles of 3-4 um over protracted periods of time. Currently, there is a limited understanding of the mechanisms of quartz toxicity, including its mechanisms for lung carcinogenicity. Additional studies are needed to determine whether the cell transforming activity of quartz is related to its carcinogenic potential.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Respiratory Protection

For nuisance exposures use type P95 (US) particle respirator. For higher level protection use type OV/AGP99 (US) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US).

b. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

c. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

d. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Gloves must be inspected prior to use. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with SBA-15 must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for SBA-15.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using SBA-15 must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of SBA-15 and understand the hazards.

Lab workers using SBA-15 must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with SBA-15 described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this SBA-15 in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this SBA-15 with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material, the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using SBA-15. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

SBA-15 for ALD reactor

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Add SBA-15 (50 mg) into the sample holder of ALD reactor in the chemical hood.
3. Connect the sample holder with SBA-15 to the ALD reactor.
4. Tighten the 2.75 inch flange.
5. Start slowly pumping the system.
6. Heat the sample holder with SBA-15 to desired temperature.
7. Expose the sample with ALD cycles.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 9/24/2015

Sebacic acid

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sebacic acid (C₁₀H₁₈O₄ CAS No. 111-20-6) is used in laboratory. Its purpose is not to have any accident or risk. Sebacic acid is harmful if inhaled, if swallowed, and if absorbed through skin. It may cause respiratory tract irritation, skin irritation, and eye irritation.

Synonyms: Decanedioic acid

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: **not known**

GHS Classification

Acute toxicity, Oral (Category 5)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sebacic acid must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sebacic acid.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sebacic acid must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sebacic acid and understand the hazards.

Lab workers using sebacic acid must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sebacic acid described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 5 g of this sebacic acid in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sebacic acid with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sebacic acid. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of Cd linker with –COOH group

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Weigh 0.3 g of sebacic acid on the balance located in room 137.
3. Bring the reagent into the fume hood and add it into the two-neck round bottom flask for condensation reaction.
4. After reaction, the filtrate needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 06/01/2013, updated 03/01/2014

Silica gel

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when silica gel (SiO₂, CAS No. 112926-00-8) is used in laboratory. Its purpose is not to have any accident or risk. Silica gel may be harmful if inhaled, if swallowed and if absorbed through skin. It may cause skin, eye and respiratory tract irritation.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Target Organ Effect (Lungs)

GHS Classification

N/A

Signs and Symptoms of Exposure

Amorphous silica is not classifiable as to its carcinogenicity to humans (Group 3); however, crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1, IARC). Therefore, amorphous silica should be handled as if possessing the same hazards as the crystalline form., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with silica gel must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for silica gel.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using silica gel must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of silica gel and understand the hazards.

Lab workers using silica gel must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with silica gel described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 g of this silica gel in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this silica gel with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using silica gel. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Column

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. In fume hood, pour out about 1 cm height of silica into a pipette whose narrow end is sealed with a cotton plug. Add sodium sulfate (1 cm height) on it.
3. Pass ether solution of benzaldehyde or hexanal or benzyl alcohol through it into a labeled vial.
4. Pour out solid into a solid waste container after reaction is done.
5. Rinse pipette and dispose into glass waste container.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 06/01/2015

Silicon dioxide

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when silicon dioxide (Aerosil 200) (SiO₂, CAS No. 7613-86-9) is used in laboratory. Its purpose is not to have any accident or risk. Silicon dioxide causes skin and eye irritation. It may be harmful if inhaled or if swallowed.

Synonyms: Silica

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Target Organ Effect (Lungs), Irritant
GHS Classification

Acute toxicity, Oral (Category 5)

Eye irritation (Category 2A)

Specific target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

Prolonged inhalation of crystalline silica may result in silicosis, a disabling pulmonary fibrosis characterized by fibrotic changes and miliary nodules in the lungs, a dry cough, shortness of breath, emphysema, decreased chest expansion, and increased susceptibility to tuberculosis. In advanced stages, loss of appetite, pleuritic pain, and total incapacity to work. Advanced silicosis may result in death due to cardiac failure or destruction of lung tissue. Crystalline silica is classified as group 1 "known to be carcinogenic to humans" by IARC and "sufficient evidence" of carcinogenicity by the NTP. The chronic health risks are associated with respirable particles of 3-4 um over protracted periods of time. Currently, there is a limited understanding of the mechanisms of quartz toxicity, including its mechanisms for lung carcinogenicity. Additional studies are needed to determine whether the cell transforming activity of quartz is related to its carcinogenic potential.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Respiratory Protection

For nuisance exposures use type P95 (US) particle respirator. For higher level protection use type OV/AGP99 (US) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US).

b. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

c. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

d. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Gloves must be inspected prior to use. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with silicon dioxide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for silicon dioxide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using silicon dioxide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of silicon dioxide and understand the hazards.

Lab workers using silicon dioxide must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with silicon dioxide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this silicon dioxide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this silicon dioxide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using silicon dioxide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Weighing Silica Powder

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, safety goggles, and dust mask/respirator.
2. Bring the chemical bottle to a balance.
3. Weigh the desired amount of silica carefully not to spill. In case of spill, hold your breath and wipe the bench top around the balance with wet paper towel.
4. After weighing, bring the silica to a fume hood to transfer it into a sample container.
5. Dispose your gloves and disposable respirator (if contaminated).
6. Wear proper PPE, decontaminate the balance and bench tops using soap and water.

Catalyst Preparation

1. Wear dust respirator, nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Bring silica aerosil to the balance. Use a nickel spoon to transfer silica aerosil into the designated vessel or weighing paper.
3. Close and seal the bottle and put it back.
4. Discard extra silica aerosil to designated chemical waste container. Clean the balance with brush.
5. Use designated solvent to dissolve silica aerosil and mix with metal precursor. Heat and dry under designated conditions.

Synthesis of silica spheres

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of tetraethyl orthosilicate, ethanol, and ammonium hydroxide again; especially remind first aid measures, handling and storage, & PPE.*
3. Place an Erlenmeyer flask into a fume hood and put a stir bar into it.
4. Add ethanol (72 mL) and milli-Q water (12 mL) to the flask and close with rubber septum. Stir for 5 minutes.
5. Take the bottle of ammonium hydroxide from a corrosive base cabinet and place it into the fume hood. Remove the septum from the flask and add ammonium hydroxide (1.95 mL) by using a micropipette. Stir for 5 minutes.
6. Take tetraethyl orthosilicate (TEOS) from the flammable cabinet and put it into the fume hood. Add TEOS (2.55 mL) to the mixture.
7. Stir for 4 hours at room temperature.
8. *Centrifuge and dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.*
9. Label the centrifuge tube appropriately, cover it with perforated aluminum foil and dry the powder in a vacuum desiccator overnight.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name

 Signature

Approval Date: 02/01/2013, updated 03/01/2014, 05/15/2016

Silicon oil

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when silicon oil (poly(dimethylsiloxane), CAS No. 63148-62-9) is used in laboratory. Its purpose is not to have any accident or risk. Silicon oil is harmful if inhaled, swallowed, or absorbed through skin. It may cause eye, skin, or respiratory tract irritations.

Synonyms: Poly(dimethylsiloxane)

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: not known

GHS Classification

Not a dangerous substance according to GHS

Signs and Symptoms of Exposure

Prolonged or repeated exposure to skin causes defatting and dermatitis., Dizziness, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with silicon oil must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.

- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for silicon oil.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using silicon oil must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of silicon oil and understand the hazards.

Lab workers using silicon oil must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with silicon oil described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 g of this silicon oil in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this silicon oil with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using silicon oil. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Oil bath

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Silicon Oil is used as the boiling oil in the oil bath, which is used to heat the chemical precursor.
3. Pour the Silicon Oil into a beaker (250 mL). Do not over fill and the volume of the liquid will expand once it is heated.
4. Put the beaker under the precursor container to make sure the entire container is merged into the silicon oil.
5. Heat the beaker using heating stage or heating tape to desired temperature (above 200 °C).
6. Once finish, stop heating and cover the beaker with aluminum foil.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 06/01/2013, updated 03/01/2014, 03/01/2016

Silver Nitrate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when silver nitrate (AgNO_3 , CAS No. 7761-88-8) used in laboratory. Its purpose is not to have any accident or risk. Silver nitrate is oxidizer, so it may intensify fire. It also causes severe skin burns and eye damage. It is harmful if swallowed and very toxic to aquatic life.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Oxidizer, Corrosive, Carcinogen, Target Organ Effect (Eyes, Nerves, Blood, Lungs), Harmful by Ingestion

GHS Classification

- Oxidizing solids (Category 2)
- Acute toxicity, Oral (Category 4)
- Skin corrosion (Category 1B)
- Serious eye damage (Category 1)
- Acute aquatic toxicity (Category 1)

Signs and Symptoms of Exposure

May cause argyria (a slate-gray or bluish discoloration of the skin and deep tissues due to the deposit of insoluble albuminate of silver). Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Small** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with silver nitrate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for silver nitrate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using silver nitrate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of silver nitrate and understand the hazards.

Lab workers using silver nitrate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with silver nitrate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;

- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 5 g of this silver nitrate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this silver nitrate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using silver nitrate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Synthesis of Silver Nanoparticles on Titania support

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Add TiO₂-P25 (100 mg) and silver nitrate solution (0.05 M, 40 mL) into a two-neck round-bottom flask (50 mL).
3. Stir the mixture and illuminate it by UV light for 3 h at 80 °C.
4. Wash the silver decorated TiO₂ nanoparticles 4 times with deionized water by centrifuging at 10,000 rpm for 6 min.
5. Dry the catalyst for 12 h under vacuum.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 11/01/2015

Sodium

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium (Na, CAS No. 7440-23-5) used in laboratory. Its purpose is not to have any accident or risk. Sodium is highly flammable Solid. In contact with water releases flammable gases which may ignite spontaneously. It causes severe skin burns and eye damage.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Flammable Solid, Emit flammable gases in contact with water, Corrosive

GHS Classification

Flammable Solid (Category 1)
Skin corrosion (Category 1B)
Serious eye damage (Category 1)

Signs and Symptoms of Exposure

Burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium and understand the hazards.

Lab workers using sodium must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 1 g of this sodium in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

5) discuss ALL issues or concerns regarding this sodium with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

4-Methyl-2,6-heptanedione

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Add sodium (1.8 g, 50 mmol) and ethanol (24 mL) into a flask (100 mL).
3. Add 2,4,6-trimethylpyridine (6.5 mL, 50 mmol) into the flask.
4. Reflux the mixture for 1 h at 90 °C in oil bath.
5. Prepare a solution of hydroxylamine hydrochloride (3.6 g, 53 mmol) in 50% ethanol (6.4 mL) and HCl (3.2 mL) in 95% ethanol (6.4 mL).
6. Add the solution slowly into the flask.
7. Reflux the mixture for 2.5 h.
8. Cool down the mixture to room temperature.
9. Remove ethanol from the mixture under evaporator.
10. Add a NaOH solution (3.5 g in 50 mL water) to the residue.
11. Extract the solution with ether (50 mL).
12. Acidify the aqueous solution with 10% H₂SO₄ (35 mL).
13. Add sodium nitrite solution (3.5 g, 50 mmol in 10 mL water) into the mixture.
14. Stir the mixture for 1 h at 0 °C.
15. Extract the mixture with ether (20 mL, 4 times)
16. Wash the organic phase with water and brine.
17. Column the residue with a hexane solution (hexane:ether = 10:2).

SOP Reviewed and Approved by:

Francisco Zaera

 Print name

 Signature

Approval Date: 06/01/2015

Sodium borohydride STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium borohydride (H_4BNa , CAS No. 16940-66-2) is used in laboratory. Its purpose is not to have any accident or risk. Sodium borohydride is corrosive and toxic if swallowed or in contact with skin. It causes severe skin burns and eye damage. In contact with water, it releases flammable gases, which may ignite spontaneously.

Synonyms: Sodium tetrahydridoborate

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: **Water Reactive**, Corrosive, Toxic by Ingestion and by Skin absorption
GHS Classification

- Substances, which in contact with water, emit flammable gases (Category 1)
- Acute toxicity, Oral (Category 3)
- Acute toxicity, Dermal (Category 4)
- Skin corrosion (Category 1B)
- Serious eye damage (Category 1)

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill

kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using hexane or other solvent. **Do not flush with water.** Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.

- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium borohydride must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium borohydride.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium borohydride must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium borohydride and understand the hazards.

Lab workers using sodium borohydride must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium borohydride described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 25 g of this sodium borohydride in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium borohydride with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium borohydride. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of PAMAM-Pt

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Weigh sodium borohydride (0.05 g), and dissolve it in deionized water (2 mL).
3. Bring the sodium borohydride solution into a fume hood, and introduce it into the PAMAM-Pt complex solution.
4. The reduction is conducted at room temperature with stirring.
5. After reaction, the filtrate needs to be treated as hazardous waste.
6. Washing and cleaning solvents also need to be treated as hazardous waste.

Gold nanoparticle preparation 2

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Add Milli-Q water (1 mL) to hydrogen tetrachloroaurate trihydrate (1 mg).
3. Prepare stock solution by adding 18 μ L of the solution (step 2) into Milli-Q water (10 mL).
4. Add 0.5 mL of this stock solution to Milli-Q water (18.5 mL).
5. Add sodium citrate (10 mM, 0.5 mL) and 0.5 mL of sodium borohydride (0.5 mL).
6. Stir for 5 min.
7. Un-used gold particles should be discarded as hazardous waste.

Au Nanoparticle (3 nm) Preparation

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Prepare Au precursor solution (0.01 M), cethyltrimethylammonium bromide solution (CTAB, 0.1 M), and NaBH₄ solution (0.01 M).
3. Add the Au solution (0.25 mL, 0.01 M) and the CTAB solution (7.5 mL, 0.1 M) into a vial.
4. Stir the mixture until bright brown-yellow color.
5. Add ice-cold NaBH₄ solution (0.6 mL).
6. Mixing for 2 min
7. After color change to pale brown-yellow, store the vial in refrigerator.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014, 03/02/2016

Sodium bromide STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium bromide (NaBr, CAS No. 7647-15-6) is used in laboratory. Its purpose is not to have any accident or risk. Sodium bromide may be harmful if swallowed or in contact with skin. It causes eye irritation.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Target Organ Effect (Central nervous system)

GHS Classification

Acute toxicity, Dermal (Category 5)

Acute toxicity, Oral (Category 5)

Eye irritation (Category 2B)

Signs and Symptoms of Exposure

Effects due to ingestion may include sedation.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium bromide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium bromide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium bromide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium bromide and understand the hazards.

Lab workers using sodium bromide must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium bromide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 5 g of this sodium bromide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium bromide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium bromide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Pt Catalyst Preparation

1. Wear dust respirator, chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Bring sodium bromide bottle to a balance. Transfer sodium bromide into a designated vessel.
3. Close and seal the bottle and put it back.
4. Discard extra sodium bromide to designated chemical waste container. Clean the balance with brush.
5. Use designated solvent to dissolve sodium bromide and add to metal precursor solution.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014

Sodium chloride

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium chloride (NaCl, CAS No. 7647-14-5) is used in laboratory. Its purpose is not to have any accident or risk. Sodium chloride may cause eye, skin or respiratory irritation. It may be harmful if inhaled, if absorbed through skin, or if swallowed.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: not known

GHS Classification

Not a dangerous substance according to GHS

Signs and Symptoms of Exposure

Vomiting, Diarrhea, Dehydration and congestion may occur in internal organs. Hypertonic salt solutions can produce inflammatory reactions in the gastrointestinal tract.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium chloride must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium chloride.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium chloride must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium chloride and understand the hazards.

Lab workers using sodium chloride must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium chloride described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 g of this sodium chloride in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium chloride with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium chloride. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 06/01/2013

Sodium citrate tribasic dihydrate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium citrate tribasic dihydrate ($C_6H_5Na_3O_7 \cdot 2H_2O$, CAS No. 6132-04-3) is used in laboratory. Its purpose is not to have any accident or risk. Sodium citrate tribasic dihydrate may be harmful if inhaled and swallowed. It may cause skin and eye irritation.

Synonyms: Trisodium citratedihydrate, Citric acidtrisodium salt dihydrate

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Sodium citrate tribasic dihydrate is commercially available, and used mostly for nanostructured catalysts in Zaera group. A variety of organic solvents are used to clean sample containers. Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Not known

GHS Classification

N/A

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium citrate tribasic, dihydrate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium citrate tribasic dihydrate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium citrate tribasic dihydrate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium citrate tribasic, dihydrate and understand the hazards.

Lab workers using sodium citrate tribasic dihydrate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium citrate tribasic dihydrate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);

- 4) employ < 25 g of this sodium citrate tribasic dihydrate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium citrate tribasic dihydrate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium citrate tribasic dihydrate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Gold Nanoparticle Preparation 1

1. Wear a nitrile chemical-resistant glove, mask, flame-resistant lab coat, and safety goggles.
2. Weigh 0.1 g of sodium citrate tribasic dihydrate.
3. Put the sodium citrate tribasic dihydrate into a beaker.
4. Pour a proper amount of milli-Q water in the beaker and stirring smoothly.
5. Take a proper amount of sodium citrate tribasic dihydrate by pipette.
6. Inject the sodium citrate tribasic dihydrate solution into gold chloride trihydrate solution.

Gold Nanoparticle Preparation 2

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Add 0.5 mL of Au Nanoparticle stock solution to 18.5 mL of millipore H₂O.
3. Add 0.5 mL of sodium citrate (10 mM) and 0.5 mL of sodium borohydride.
4. Stir for 5 min.
5. Un-used gold particles should be discarded as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name

 Signature

Approval Date: 02/01/2013, updated 03/01/2014, 10/01/2014

Sodium hydroxide

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium hydroxide (NaOH, CAS No. 1310-73-2) is used in laboratory. Its purpose is not to have any accident or risk. Sodium hydroxide is corrosive solid. It causes severe skin burns and eye damage. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. Also, It may be harmful if inhaled, if absorbed through skin, or if swallowed.

Synonyms: Caustic soda

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Corrosive

GHS Classification

- Skin corrosion (Category 1A)
- Serious eye damage (Category 1)
- Acute aquatic toxicity (Category 3)

Signs and Symptoms of Exposure

Spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Small** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium hydroxide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium hydroxide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium hydroxide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium hydroxide and understand the hazards.

Lab workers using Corrosive Solid must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium hydroxide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;

- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 25 g of this sodium hydroxide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium hydroxide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium hydroxide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Sodium Hydroxide Solution Preparation

1. Wear dust respirator, gloves, flame-resistant lab coat, and safety goggles.
2. Bring sodium hydroxide to the balance. Transfer sodium hydroxide into the designated vessel quickly.
3. Close and seal the bottle and put it back.
4. Discard extra sodium hydroxide to designated chemical waste container. Clean the balance with brush.
5. Use designated solvent to dissolve sodium hydroxide and the extra unused solution needs to be treated as hazardous waste.

Preparation of 2 M sodium hydroxide solution for silica etching

1. Wear nitrile chemical-resistant glove, mask, flame-resistant lab coat, and safety goggles.
2. Weigh proper amount of sodium hydroxide.
3. Put the sodium hydroxide into a beaker.
4. Pour a proper amount of milli-Q water in the beaker and stir smoothly.

4-Methyl-2,6-heptanedione

1. Wear nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Add sodium (1.8 g, 50 mmol) and ethanol (24 mL) into a flask (100 mL).
3. Add 2,4,6-trimethylpyridine (6.5 mL, 50 mmol) into the flask.
4. Reflux the mixture for 1 h at 90 °C in oil bath.
5. Prepare a solution of hydroxylamine hydrochloride (3.6 g, 53 mmol) in 50% ethanol (6.4 mL) and HCl (3.2 mL) in 95% ethanol (6.4 mL).

6. Add the solution slowly into the flask.
7. Reflux the mixture for 2.5 h.
8. Cool down the mixture to room temperature.
9. Remove ethanol from the mixture under evaporator.
10. Add a NaOH solution (3.5 g in 50 mL water) to the residue.
11. Extract the solution with ether (50 mL).
12. Acidify the aqueous solution with 10% H₂SO₄ (35 mL).
13. Add sodium nitrite solution (3.5 g, 50 mmol in 10 mL water) into the mixture.
14. Stir the mixture for 1 h at 0 °C.
15. Extract the mixture with ether (20 mL, 4 times)
16. Wash the organic phase with water and brine.
17. Column the residue with a hexane solution (hexane:ether = 10:2).

Au Nanoparticle (2 nm) Preparation

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. In a round-bottom flask, Milli-Q water (45.5 mL), NaOH (0.2 M, 1.5 mL), tetrakis(hydroxymethyl)phosphonium chloride (1 mL, 120 μL diluted in 10 mL) are added in sequence.
3. The mixture is stirred for 2 min
4. Chloroauric acid solution (25 mM, 2 mL) is added.
5. The colloidal nanoparticle suspension is further stirred for 2 min
6. The suspension is stored in a plastic centrifuge tube in dark at room temperature.
7. Clean the reaction vessel with aqua regia after reaction.

Preparation of sodium hydroxide solution

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Review the SDS of sodium hydroxide and hydrochloric acid again; especially remind first aid measures, handling and storage, & PPE.*
3. Take an Erlenmeyer flask into a fume hood and add milli-Q water (50 mL) into it. Close the flask and take it to a balance.
4. Take the sodium hydroxide from a solid cabinet and take it to a balance. Weigh it (400 mg) and add it into a flask.
5. Take the closed flask into a fume hood and wait for the sodium hydroxide to disperse. Store the solution in a plastic bottle in the corrosive base cabinet.
6. Whenever using sodium hydroxide solution, *dispose the waste into the waste bottle labeled corrosive hazardous waste.*

Preparation of gold nanoparticles

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of gold chloride trihydrate, sodium hydroxide, and Tetrakis(hydroxymethyl)phosphonium chloride again; especially remind first aid measures, handling and storage, & PPE.*
3. Place a very clean one neck round bottom flask into a fume hood and put a stir bar into it.
4. Take gold chloride trihydrate from inorganic acid cabinet and take it to a balance. Weigh it (157.6 mg) and add it into a centrifuge tube. Close the centrifuge tube and transfer it to the fume hood. Add milli-Q water (20 mL) to the centrifuge tube.
5. Add milli-Q water (364 mL) to the round-bottom flask.
6. Take sodium hydroxide solution (0.2 M) from a corrosive base cabinet and place it into the fume hood. Add water (12 mL) in the round-bottom flask.
7. Separately in a centrifuge tube prepare a solution of tetrakis(hydroxymethyl) phosphonium chloride in water. First take the bottle of tetrakis(hydroxymethyl) phosphonium chloride from the flammable cabinet and place it into the fume hood. Add milli-Q water (8 mL) into the centrifuge tube. Next, add tetrakis (hydroxymethyl)phosphonium chloride (96 μ L) into it. Stir and add the mixture to the round bottom flask.
8. Stir the mixture in the closed round-bottom flask for 2 minutes. Then, add the mixture of gold chloride trihydrate and water and stir for another 2 minutes.
9. Save the gold solution in appropriately labeled centrifuge tubes.
10. When using the gold solution, *dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.*

Partial etching of titania shells

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic and corrosive hazardous waste. Review the SDS of sodium hydroxide and hydrochloric acid again; especially remind first aid measures, handling and storage, & PPE.*
3. Place an Erlenmeyer flask into a fume hood and put a stir bar into it.
4. Disperse titania shells with a silica core in milli-Q water (20 mL) and add the dispersion to the flask.
5. Take sodium hydroxide solution (2.5 M) from a corrosive base cabinet and place it into the fume hood. With a micropipette add sodium hydroxide solution (1 mL of 2.5 M) and close with the septum. Stir for 20 minutes.

6. Wash three times with water and **dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.**
7. Disperse partially etched titania shells with a silica core in milli-Q water (10 mL) and add the dispersion to a clean flask.
8. Take hydrochloric acid solution (0.5 M) from inorganic acid cabinet and place it into the fume hood. With a micropipette add hydrochloric acid solution (2 mL of 0.5 M) and close with the septum. Stir for 30 minutes.
9. Wash three times with water and two times with ethanol. **Dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.**
10. Label the centrifuge tube appropriately, cover it with perforated aluminum foil and dry the powder in a vacuum desiccator overnight.


Full etching of titania shells

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic and corrosive hazardous waste. Review the SDS of sodium hydroxide and hydrochloric acid again; especially remind first aid measures, handling and storage, & PPE.*
3. Place an Erlenmeyer flask into a fume hood and put a stir bar into it.
4. Disperse titania shells with a silica core in milli-Q water (20 mL) and add the dispersion to the flask.
5. Take sodium hydroxide solution (2.5 M) from a corrosive base cabinet and place it into the fume hood. With a micropipette add sodium hydroxide solution (4 mL of 2.5 M) and close with the septum. Stir for 6 hours.
6. Wash three times with water and two times with ethanol. **Dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.**
7. Label the centrifuge tube appropriately, cover it with perforated aluminum foil and dry the powder in a vacuum desiccator overnight.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name



 Signature

Approval Date: 06/01/2013, updated 03/01/2014, 03/01/2016, 05/15/2016

Sodium hypochlorite solution STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium hypochlorite solution (ClNaO, CAS No. 7681-52-9) is used in laboratory. Its purpose is not to have any accident or risk. Sodium hypochlorite solution is corrosive and causes severe skin burns and eye damage. Also it is very toxic to aquatic life.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Corrosive

GHS Classification

- Skin corrosion (Category 1B)
- Serious eye damage (Category 1)
- Acute aquatic toxicity (Category 1)

Signs and Symptoms of Exposure

Burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, Pneumonitis, Pulmonary edema. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium hypochlorite solution must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium hypochlorite solution.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium hypochlorite solution must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium hypochlorite solution and understand the hazards.

Lab workers using sodium hypochlorite solution must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium hypochlorite solution described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);

- 4) employ < 100 mL of this sodium hypochlorite solution in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium hypochlorite solution with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium hypochlorite solution. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013

Sodium iodate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium iodate (NaO₃I, CAS No. 7681-55-2) used in laboratory. Its purpose is not to have any accident or risk. Sodium iodate is oxidizer, so it may intensify fire. It may cause eye, skin, or respiratory irritation. Also, it may be harmful if swallowed, if inhaled, or if absorbed through skin.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Oxidizer, Target Organ (Thyroid, Blood, Bone marrow) Effect, Harmful by Ingestion, Skin and respiratory sensitizer

GHS Classification

- Oxidizing solids (Category 2)
- Acute toxicity, Oral (Category 4)
- Respiratory sensitization (Category 1)
- Skin sensitization (Category 1)

Signs and Symptoms of Exposure

Nausea, Vomiting, Diarrhea, Rash

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium iodate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium iodate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium iodate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium iodate and understand the hazards.

Lab workers using sodium iodate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium iodate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.


When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 25 g of this sodium iodate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium iodate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium iodate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

SOP Reviewed and Approved by:

Francisco Zaera
Print name


Signature

Approval Date: 06/01/2013

Sodium mesoxalate monohydrate STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium mesoxalate monohydrate ($C_3H_2Na_2O_6$, CAS No. 31635-99-1) is used in laboratory. Its purpose is not to have any accident or risk. Sodium mesoxalate monohydrate may be harmful if inhaled, if swallowed and if absorbed through skin. It may cause skin, eye and respiratory tract irritation.

Synonyms: Mesoxalic aciddisodium saltmonohydrate, Dihydroxymalonic aciddisodium salt

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Not known

GHS Classification

N/A

Signs and Symptoms of Exposure

No data is available.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium mesoxalate monohydrate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium mesoxalate monohydrate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium mesoxalate monohydrate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium mesoxalate monohydrate and understand the hazards.

Lab workers using sodium mesoxalate monohydrate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium mesoxalate monohydrate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this sodium mesoxalate monohydrate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this sodium mesoxalate monohydrate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium mesoxalate monohydrate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.


HPLC Sample Preparation

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Take sodium mesoxalate monohydrate out of the fridge and bring the bottle to the balance.
3. Use a nickel spoon to transfer sodium mesoxalate monohydrate into the designated vessel or weighing paper.
4. Close and seal the bottle and put it back to the fridge.
5. Discard extra sodium mesoxalate monohydrate to designated chemical waste container. Clean the balance with brush.
6. Use designated solvent to dissolve sodium mesoxalate monohydrate and the sample solution needs to be treated as hazardous waste after measurement.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name



 Signature

Approval Date: 02/01/2013, updated 03/01/2014

Sodium metatitanate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium metatitanate ($\text{Na}_2\text{Ti}_3\text{O}_7$, CAS No. 12034-36-5) is used in laboratory. Its purpose is not to have any accident or risk. Sodium metatitanate may cause eye, skin or respiratory irritation. It may be harmful if inhaled, if swallowed or if absorbed through skin.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: not known

GHS Classification

Not a dangerous substance according to GHS

Signs and Symptoms of Exposure

N/A

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium metatitanate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium metatitanate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium metatitanate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium metatitanate and understand the hazards.

Lab workers using sodium metatitanate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium metatitanate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 50 g of this sodium metatitanate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this sodium metatitanate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium metatitanate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 06/01/2013

Sodium nitrate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium nitrate (NaNO₃, CAS No. 7631-99-4) used in laboratory. Its purpose is not to have any accident or risk. Sodium nitrate is oxidizer, so it may intensify fire. It is harmful if swallowed, if inhaled, and if absorbed through skin. It may cause respiratory tract irritation, skin irritation, and eye irritation.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Oxidizer, Harmful by Ingestion, Target Organ Effect (Blood, Central nervous system)

GHS Classification

- Oxidizing solids (Category 3)
- Acute toxicity, Oral (Category 4)
- Skin irritation (Category 2)
- Eye irritation (Category 2A)
- Specific target organ toxicity – single exposure (Category 3)
- Acute aquatic toxicity (Category 1)

Signs and Symptoms of Exposure

Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Small** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium nitrate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium nitrate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium nitrate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium nitrate and understand the hazards.

Lab workers using sodium nitrate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium nitrate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;

- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this sodium nitrate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium nitrate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium nitrate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Tether chiral amine to PAMAM

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggle.
2. Weight 0.02 g of sodium nitrate on the balance located in room 137, and dissolve it in 2 mL of deionized water.
3. Bring sodium nitrate solution into the fume hood, and introduce above solution into the solution of PAMAM, and the reduction is conducted at room temperature with stirring.
4. After reaction, the filtrate needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera
 Print name

 Signature

Approval Date: 02/01/2013, updated 03/01/2014

Sodium nitrite

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium nitrite (NNaO_2 , CAS No. 7632-00-0) used in laboratory. Its purpose is not to have any accident or risk. Sodium nitrite is oxidizer, so it may intensify fire. It is toxic if swallowed and very toxic to aquatic life. It may cause cancer and causes serious eye irritation.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Oxidizer, Toxic by Ingestion

GHS Classification

- Oxidizing solids (Category 3)
- Acute toxicity, Oral (Category 3)
- Eye irritation (Category 2A)
- Acute aquatic toxicity (Category 1)

Signs and Symptoms of Exposure

Headache, Nausea, Incoordination., Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium nitrite must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium nitrite.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium nitrite must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium nitrite and understand the hazards.

Lab workers using sodium nitrite must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium nitrite described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 25 g of this sodium nitrite in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this sodium nitrite with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium nitrite. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

4-Methyl-2,6-heptanedione

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Add sodium (1.8 g, 50 mmol) and ethanol (24 mL) into a flask (100 mL).
3. Add 2,4,6-trimethylpyridine (6.5 mL, 50 mmol) into the flask.
4. Reflux the mixture for 1 h at 90 °C in oil bath.
5. Prepare a solution of hydroxylamine hydrochloride (3.6 g, 53 mmol) in 50% ethanol (6.4 mL) and HCl (3.2 mL) in 95% ethanol (6.4 mL).
6. Add the solution slowly into the flask.
7. Reflux the mixture for 2.5 h.
8. Cool down the mixture to room temperature.
9. Remove ethanol from the mixture under evaporator.
10. Add a NaOH solution (3.5 g in 50 mL water) to the residue.
11. Extract the solution with ether (50 mL).
12. Acidify the aqueous solution with 10% H₂SO₄ (35 mL).
13. Add sodium nitrite solution (3.5 g, 50 mmol in 10 mL water) into the mixture.
14. Stir the mixture for 1 h at 0 °C.
15. Extract the mixture with ether (20 mL, 4 times)
16. Wash the organic phase with water and brine.
17. Column the residue with a hexane solution (hexane:ether = 10:2).

SOP Reviewed and Approved by:

 Francisco Zaera
 Print name

 Signature

Approval Date: 06/01/2015

Sodium silicate solution

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium silicate solution (Mixture, disodium metasilicate Na₂SiO₃, CAS No. 6834-92-0; silicon dioxide SiO₂, CAS No. 7631-86-9) used in laboratory. Its purpose is not to have any accident or risk. Sodium silicate solution is toxic if swallowed. Also it is harmful if inhaled.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Corrosive, Toxic by skin absorption

GHS Classification

Skin corrosion (Category 1A)

Serious eye damage (Category a)

Specific target organ toxicity – single exposure (Category 3)

Specific target organ toxicity – repeated exposure (Category 1)

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea.
Stomach - Irregularities - Based on Human Evidence

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Respiratory Protection

Where risk assessment shows air-purifying respirators are appropriate sue a full-face respirator with multi-purpose combination. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US).

b. Eye Protection

Face shield and ANSI compliant safety glasses with side shields should be worn. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US). Chemical splash goggles should be worn when working with larger quantities. If chemical has a

skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

c. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. Complete suit protecting against chemicals. The type of protection equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

d. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove or butyl-rubber gloves for splash. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly.

Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium silicate solution must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium silicate solution.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium silicate solution must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium silicate solution and understand the hazards.

Lab workers using sodium silicate solution must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation,

canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium silicate solution described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines factors) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this sodium silicate solution in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium silicate solution with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium silicate solution. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Formation of outer silica shell on Au shell

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. In a fume hood, aqueous sodium silicate solution (1.83 mL, containing 2.16-10 wt % SiO₂, pH 9.5) is added to dilute aqueous solution of particles with Si core radius and Au shell under vigorous stirring.
3. Wash suspension with ethanol, by consecutive centrifugation and decantation.
4. Discard washings as Hazardous aqueous waste.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 10/01/2014

Sodium sulfate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sodium sulfate ($\text{Na}_2\text{O}_4\text{S}$ CAS No. 7757-82-6) is used in laboratory. Its purpose is not to have any accident or risk. Sodium sulfate is harmful to aquatic life.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: not known

GHS Classification

Acute aquatic toxicity (Category 3)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sodium sulfate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sodium sulfate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sodium sulfate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sodium sulfate and understand the hazards.

Lab workers using sodium sulfate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sodium sulfate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines factors) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 g of this sodium sulfate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this sodium sulfate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sodium sulfate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Catalytic Reaction

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and a safety goggles.
2. Take 31 mg of 2-Hydroxybenzyl alcohol into a 30 mL Erlenmeyer flask in the fume hood.
3. Add potassium carbonate (103.7 mg) and water (5 mL).
4. Add aqueous Au-PVP catalyst (0.5 mM, 10 mL, 2 atom.%), and stir at 1300 rpm.
5. Quench reaction with HCl (1 M), extract with ethyl acetate, dry organic layer over sodium sulfate.
6. Run on GC.
7. Dispose off ethyl acetate as hazardous organic waste.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 03/11/2016

Strontium 2,4,5-tri-tert-butylimidazole STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when strontium 2,4,5-tri-tert-butylimidazole (C₁₅H₂₈N₂, CAS No. N/A) is used in laboratory. Its purpose is not to have any accident or risk. Strontium 2,4,5-tri-tert-butylimidazole causes skin and eye irritation.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Not known

GHS Classification

N/A

Signs and Symptoms of Exposure

No data is available.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-line hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with strontium 2,4,5-tri-tert-butylimidazole must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for strontium 2,4,5-tri-tert-butylimidazole.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using strontium 2,4,5-tri-tert-butylimidazole must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of strontium 2,4,5-tri-tert-butylimidazole and understand the hazards.

Lab workers using strontium 2,4,5-tri-tert-butylimidazole must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with strontium 2,4,5-tri-tert-butylimidazole described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 1 g of this strontium 2,4,5-tri-tert-butylimidazole in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this strontium 2,4,5-tri-tert-butylimidazole with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using strontium 2,4,5-tri-tert-butylimidazole. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Operating the glove box

(Strontium 2,4,5-tri-butylimidazole is air/moisture sensitive, so it cannot be handled in the fume hood in room 135. It should be handled inside the glove box.

1. A glove box is a sealed container that is designed to allow users to manipulate objects where an inert atmosphere is desired. It has an antechamber which has two doors connect to the glove box and the outside. Follow the steps below when operate the glove box.
2. Check the pressure gauge on ultrahigh pure Nitrogen cylinder. If the pressure is low (below 200 psi), do not use the glove and change the gas cylinder. Check the pressure gauge on the antechamber chamber. If it is under vacuum, switch the knob below the antechamber chamber from Evacuate to Refill position, and then switch back to CLOSED position. This will isolate the antechamber chamber from the glove box.
3. Open the outside door carefully, and then transfer the new chemicals, container (made by a glass metal adapter) with valves, tools onto the tray inside. Close the outside door.
4. Switch the knob from Closed to Evacuate, wait for 5 mins. Then move to Refill position. The pressure in the antechamber chamber will increase. Evacuate and Refill the antechamber chamber two more times. It is suggested to leave the knob in Closed position after the 3rd refill.
5. Put hands in the glove box and open the inside door slowly, monitor the oxygen and water level on the control panel (both should be below 1 ppm). Move the tray inside the glove box and transfer the chemical precursor into the container. Connect the container to a valve and close the valve. Leave the air/sensitive chemical bottle inside the glove box. Label the bottle with chemical name and user name and contact information.
6. Transfer the container with valve and all tools back to the antechamber chamber. Close the inside door.
7. Make sure the knob is at Closed position. Open the outside door and remove all the items from the chamber. Then close the outside door. Switch the knob to Evacuate position.

Using the precursor.

1. Connect the container to the leak valve by CF fitting.
2. The chemical precursor must be pre-pumped before open the leak valve.
3. Side-pump the precursor with the mechanical pump first.
4. Slowly open the leak valve to further pump the precursor.
5. Heating of the (Strontium 2,4,5-tri-butylimidazole precursor is achieved by putting a silicon oil bath around the precursor container. Control the oil bath temperature to 150 °C, and
6. Open the leak valve to reach the desired vapor pressure.
7. Close the leak valve when the exposure is finished.
8. Close the container valve.
9. Stop heating the silicon oil bath.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014

Succinic acid

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when succinic acid (C₄H₆O₄, CAS No. 110-15-6) is used in laboratory. Its purpose is not to have any accident or risk. Succinic acid may be harmful if swallowed. It causes serious eye, skin and respiratory irritation.

Synonyms: Butanedioic acid

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Irritant

GHS Classification

Acute toxicity, Oral (Category 5)

Skin irritation (Category 2)

Serious eye damage (Category 1)

Specific target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with succinic acid must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for succinic acid.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using succinic acid must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of succinic acid and understand the hazards.

Lab workers using succinic acid must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with succinic acid described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 g of this succinic acid in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this succinic acid with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using succinic acid. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of Cd linker with –COOH group

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Weigh 0.3 g of succinic acid on the balance located in room 137.
3. Bring the reagent into the fume hood and add it into the two-neck round bottom flask for condensation reaction.
4. After reaction, the filtrate needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014

Sulfuric acid

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sulfuric acid (H_2O_4S , CAS No. 7664-93-9) is used in laboratory. Its purpose is not to have any accident or risk. Sulfuric acid is corrosive liquid. It causes severe skin burns and eye damage.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Corrosive, Target Organ Effect (Teeth, Lungs)

GHS Classification

Skin corrosion (Category 1A)

Serious eye damage (Category 1)

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Pulmonary edema. Effects may be delayed., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Small** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- **Large**– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sulfuric acid must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sulfuric acid.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sulfuric acid must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sulfuric acid and understand the hazards.

Lab workers using sulfuric acid must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sulfuric acid described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 50 mL of this sulfuric acid in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this sulfuric acid with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sulfuric acid. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

4-Methyl-2,6-heptanedione

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Add sodium (1.8 g, 50 *mmol*) and ethanol (24 mL) into a flask (100 mL).
3. Add 2,4,6-trimethylpyridine (6.5 mL, 50 *mmol*) into the flask.
4. Reflux the mixture for 1 h at 90 °C in oil bath.
5. Prepare a solution of hydroxylamine hydrochloride (3.6 g, 53 *mmol*) in 50% ethanol (6.4 mL) and HCl (3.2 mL) in 95% ethanol (6.4 mL).
6. Add the solution slowly into the flask.
7. Reflux the mixture for 2.5 h.
8. Cool down the mixture to room temperature.
9. Remove ethanol from the mixture under evaporator.
10. Add a NaOH solution (3.5 g in 50 mL water) to the residue.
11. Extract the solution with ether (50 mL).
12. Acidify the aqueous solution with 10% H₂SO₄ (35 mL).
13. Add sodium nitrite solution (3.5 g, 50 *mmol* in 10 mL water) into the mixture.
14. Stir the mixture for 1 h at 0 °C.
15. Extract the mixture with ether (20 mL, 4 times)
16. Wash the organic phase with water and brine.
17. Column the residue with a hexane solution (hexane:ether = 10:2).

SOP Reviewed and Approved by:

 Francisco Zaera
 Print name

 Signature

Approval Date: 06/01/2015

Sulfuryl chloride

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when sulfuryl chloride (Cl₂O₂S, CAS No. 7791-25-5) is used in laboratory. Its purpose is not to have any accident or risk. Sulfuryl chloride has **Lachrymator** hazard, so it is rapidly absorbed through skin. Also it is fatal if inhaled. It causes severe skin burns and eye damage.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Toxic by Inhalation, Corrosive and Lachrymator.

GHS Classification

Acute toxicity, Inhalation (Category 3)

Skin corrosion (Category 1B)

Serious eye damage (Category 1)

Specific target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Cough, Shortness of breath, Headache, Nausea

3.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with sulfuryl chloride must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for sulfuryl chloride.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using sulfuryl chloride must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of sulfuryl chloride and understand the hazards.

Lab workers using sulfuryl chloride must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with sulfuryl chloride described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this sulfuryl chloride in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this sulfuryl chloride with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using sulfuryl chloride. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Sulfury chloride Sample Preparation:

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Take the glass bottle container out of the closet carefully, and put the container into the fume hood. All of the following procedures should be carried out in the fume hood.
3. Care should be taken to fast open the cap and transfer about 3 ml of the sulfuryl chloride to the flask using pipette with pyridine, and petroleum ether at the bottom in the iced acetone bath.
4. Place the glass bottle container with cap closed back to the prior spot in the closet.
5. Follow the procedure in the literature[1] to continue the experiments.
5. After experiment, the glasswares used in the experiment needs to be cleaned with acetone and water, and dried in the oven. The waste solution should be placed into the proper waste container.

[1] Roland Ohme, Helmut Preuschhof, and Hans-Ulrich Heyne, Organic Syntheses, Coll. Vol. 6, p.78 (1988); Vol. 52, p.11 (1972).

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014

Tartronic acid

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tartronic acid (C₃H₄O₅, CAS No. 80-69-3) is used in laboratory. Its purpose is not to have any accident or risk. Tartronic acid causes serious eye and skin irritation. It may be harmful if inhaled, if swallowed and if absorbed through skin. Also it may cause skin, eye and respiratory tract irritation.

Synonyms: 2-Hydroxypropanedioic acid, 2-Tartronic acid, Hydroxymalonic acid

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Irritant

GHS Classification

Eye irritation (Category 2A)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tartronic acid must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tartronic acid.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tartronic acid must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tartronic acid and understand the hazards.

Lab workers using tartronic acid must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tartronic acid described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mg of this tartronic acid in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tartronic acid with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tartronic acid. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

HPLC Sample Preparation

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Take tartronic acid out of the fridge and bring the bottle to the balance.
3. Use a nickel spoon to transfer tartronic acid into the designated vessel or weighing paper.
4. Close and seal the bottle and put it back to the fridge.
5. Discard extra tartronic acid to designated chemical waste container. Clean the balance with brush.
6. Use designated solvent to dissolve tartronic acid and the sample solution needs to be treated as hazardous waste after measurement.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014

tert-Butanol

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tert-butanol (C₄H₁₀O, CAS No. 75-65-0) used in laboratory. Its purpose is not to have any accident or risk. tert-Butanol is highly flammable liquid and vapor, and toxic if swallowed, if inhaled, or in contact with skin. It causes serious eye and skin irritation.

Synonyms: 2-Methyl-2-propanol, Trimethyl carbinol, tert-Butyl alcohol

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: **Flammable liquid, Toxic by Inhalation**

GHS Classification

Flammable liquids (Category 2)

Eye irritation (Category 2A)

Single target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

Drying, cracking of the skin, Skin irritation, Liver - Irregularities - Based on Human Evidence

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tert-butanol must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tert-butanol.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tert-butanol must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tert-butanol and understand the hazards.

Lab workers using tert-butanol must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tert-butanol described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this tert-butanol in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this tert-butanol with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tert-butanol. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Catalytic Reaction

1. Wear nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Use 5% tert-butanol + 95% DI Water as solvent for catalytic oxidation of alcohol to aldehyde.
3. In to the above mix (Step 2) add potassium carbonate (103.7 mg), benzyl alcohol (0.25 mmol) and Au-PVP suspension (0.5 mM).
4. After reaction and characterization dispose off as aqueous waste.

Catalytic Oxidation Reaction

1. Wear nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Into a test tube with a stir bar, add L-proline (16.4 mg) and acetonitrile (1 mL).
3. Ultrasonicate and stir the mixture.
4. Add tert-butanol (5 μ L).
5. Add benzaldehyde (80 μ L) and acetophenone (92 μ L).
6. Close with a rubber septum, seal with parafilm, connect the oxygen supply to the test tube, and set the temperature at 50 $^{\circ}$ C.
7. After reaction, collect the samples.
8. Run GC analysis.

Base in oxidation reactions

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic and carcinogen hazardous waste. Review the SDS of tert-butanol and benzene again; especially remind first aid measures, handling and storage, & PPE.*
3. Place a test tube into a fume hood and put a stir bar into it. Close with a rubber septum and take it to a balance. Weigh P25-TiO₂/Au catalyst (9 mg) and add it into the test tube. Transfer the closed septum back to the fume hood.

4. With a micropipette add toluene (4.5 mL), close with the septum and sonicate for about 1 minute so that the solids disperse well in the solvent.
5. Bring the mixture back to the fume hood and stir it.
6. Take tert-butanol from the flammable cabinet and put it into the fume hood. Add 10 μ L of it into the reaction mixture.
7. Before adding the internal standard benzene (12.5 μ L) *put on a full-face respirator*. Take a bottle of benzene from the flammable cabinet and place it into the fume hood. *Be careful not to spill benzene. Keep watching any leak of benzene. Avoid release to the environment. Avoid breathing fume, gas, mist, vapor or spray. If swallowed, immediately call 911. If inhaled, rinse cautiously with water for 15 min. Remove contact lenses, if present and easy to do. Continue rinsing.*
8. Remove the septum from the test tube and open the benzene bottle. Add the small amount of benzene into the test tube by using a Hamilton syringe (50 μ L). Wash the syringe with benzene three times before adding it into the reaction mixture. After adding it clean the syringe by washing it with ether. *Dispose the waste into the waste bottle labeled carcinogen hazardous waste.* Once adding benzene the handling of the reaction mixture has to be carried out with *the full-face respirator on.*
9. Put the benzene bottle back to the flammable cabinet. *Be careful not to spill benzene. Keep watching any leak of benzene. Avoid release to the environment. Avoid breathing fume, gas, mist, vapor or spray. If swallowed, immediately call 911. If inhaled, rinse cautiously with water for 15 min. Remove contact lenses, if present and easy to do. Continue rinsing.*
10. Take the reactant (e.g. benzyl alcohol, p-cymene, fluorene, etc.) from the flammable cabinet and put it into the fume hood. Add the reactant (5.5 μ L) into the reaction mixture.
11. Close the test tube with the rubber septum, seal with Teflon tape and connect the oxygen supply to the test tube.
12. Open the main valve of oxygen cylinder, which is located in a cupboard in a corridor in front of the room 135. After then, open the oxygen Swagelok needle valve in the fume hood, and fill the balloon with oxygen. Attach the balloon to a needle going through the rubber septum into the reaction mixture.
13. Transfer the test tube into the oil bath and do the catalytic reaction at temperature below 75 $^{\circ}$ C (boiling point of benzene is 80.1 $^{\circ}$ C).
14. Collect samples at different reaction times and remember to always *put on the full-face respirator* before working with the mixture. Put a sample (100 μ L) into a small centrifuge tube and centrifuge it to remove the solids.
15. After centrifuging bring the closed vial back to the fume hood and transfer the liquid into a new vial.
16. Inject the sample into GC using a Hamilton syringe (10 μ L).
17. Dispose all the waste into the appropriately labeled waste bottle.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 10/01/2014, updated 03/03/2016, 05/15/2016

tert-Butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine ($C_{10}H_{20}N_2$ CAS No. Unknown) is used in laboratory. Its purpose is not to have any accident or risk. tert-Butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine may be harmful if inhaled, swallowed, or absorbed through skin. It may cause respiratory tract, skin, or eye irritation.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: not known
GHS Classification not known

Signs and Symptoms of Exposure
Not available.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Respiratory Protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination respirator cartridges as a backup to engineering control. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use Respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US).

b. Eye Protection

ANSI compliant safety glasses with side shields conforming to EN 166 should be worn. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166 (EU). Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

c. Skin and Body Protection

Wear chemical resistant lab coat, impervious clothing, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the

individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

d. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Gloves must be inspected prior to use. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.

- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine and understand the hazards.

Lab workers using tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine

described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines factors) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 1 g of this tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Operating the glove box

tert-Butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine is air/moisture sensitive, so it cannot be handled in the fume hood in room 135. It should be handled inside the glove box.

1. A glove box is a sealed container that is designed to allow users to manipulate objects where an inert atmosphere is desired. It has an antechamber, which has two doors connect to the glove box and the outside. Follow the steps below when operate the glove box.
2. Check the pressure gauge on ultrahigh pure Nitrogen cylinder. If the pressure is low (below 200 psi), do not use the glove and change the gas cylinder. Check the pressure gauge on the antechamber chamber. If it is under vacuum, switch the knob below the antechamber chamber from Evacuate to Refill position, and then switch back to CLOSED position. This will isolate the antechamber chamber from the glove box.

3. Open the outside door carefully, and then transfer the new chemicals, container (made by a glass metal adapter) with valves, and tools onto the tray inside. Close the outside door.
4. Switch the knob from Closed to Evacuate, wait for 5 min. Then move to Refill position. The pressure in the antechamber chamber will increase. Evacuate and Refill the antechamber chamber two more times. It is suggested to leave the knob in Closed position after the 3rd refill.
5. Put hands in the glove box and open the inside door slowly, monitor the oxygen and water level on the control panel (both should be below 1 ppm). Move the tray inside the glove box and transfer the chemical precursor into the container. Connect the container to a valve and close the valve. Leave the air/sensitive chemical bottle inside the glove box. Label the bottle with chemical name and user name and contact information.
6. Transfer the container with valve and all tools back to the antechamber chamber. Close the inside door.
7. Make sure the knob is at Closed position. Open the outside door and remove all the items from the chamber. Then close the outside door. Switch the knob to Evacuate position.

UHV #1 Victor Chamber

1. Wear a nitrile glove, flame-resistant lab coat, and safety goggle.
2. Bring the empty container to the glove box and fill the container with tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine inside the glove box.
3. Seal the container before take it out of the glove box.
4. Connect the container to the UHV system, and pump down the container, and keep the tert-butyl(5,5-dimethyl-4,5-dihydro-3H-pyrrol-2-yl)amine inside the container under vacuum conditions.
5. Heat the container with silicone oil to the desired temperature (363 K) to get proper vapor pressure for surface adsorption.

SOP Reviewed and Approved by:

 Francisco Zaera
 Print name

 Signature

Approval Date: 12/01/2014

tert-Butyl hydroperoxide solution STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when *tert*-butyl hydroperoxide solution (C₄H₁₀O₂, CAS No. 75-91-2) is used in laboratory. Its purpose is not to have any accident or risk. *tert*-Butyl hydroperoxide solution is combustible liquid and has **Mutagen** hazard. It is toxic in contact with skin or if inhaled. Heating may cause a fire. It causes severe skin burns and eye damage. It is suspected of causing genetic defects.

Synonyms: TBHP

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Combustible Liquid, Organic Peroxides, Toxic by Inhalation and Skin absorption, Harmful by Ingestion, Skin Sensitizer, Corrosive, Mutagen

GHS Classification

- Flammable liquids (Category 3)
- Organic peroxides (Type F)
- Acute toxicity, Oral (Category 4)
- Acute toxicity, Inhalation (Category 3)
- Acute toxicity, Dermal (Category 3)
- Skin corrosion (Category 1B)
- Serious eye damage (Category 1)
- Skin sensitization (Category 1)
- Germ cell mutagenicity (Category 2)
- Acute aquatic toxicity (Category 2)
- Chronic aquatic toxicity (Category 2)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.

- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with *tert*-butyl hydroperoxide solution must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for *tert*-butyl hydroperoxide solution.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using *tert*-butyl hydroperoxide solution must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of *tert*-butyl hydroperoxide solution and understand the hazards.

Lab workers using *tert*-butyl hydroperoxide solution must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek

literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with *tert*-butyl hydroperoxide solution described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 25 mL of this *tert*-butyl hydroperoxide solution in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this *tert*-butyl hydroperoxide solution with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using *tert*-butyl hydroperoxide solution. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013

Tetraamineplatinum(II) chloride hydrate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetraamineplatinum(II) chloride hydrate ($H_{12}Cl_2N_4Pt \cdot xH_2O$, CAS No. 108374-32-9) is used in laboratory. Its purpose is not to have any accident or risk. Tetraamineplatinum(II) chloride hydrate causes serious eye, skin and respiratory irritation. It is harmful if swallowed, if inhaled, or in contact with skin.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Irritant

GHS Classification

- Acute toxicity, Inhalation (Category 4)
- Acute toxicity, Dermal (Category 4)
- Acute toxicity, Oral (Category 4)
- Skin irritation (Category 2)
- Eye irritation (Category 2A)
- Specific target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetraamineplatinum(II) chloride hydrate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetraamine platinum(II) chloride hydrate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetraamineplatinum(II) chloride hydrate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetraamineplatinum(II) chloride hydrate and understand the hazards.

Lab workers using tetraamineplatinum(II) chloride hydrate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetraamineplatinum(II) chloride hydrate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);

- 4) employ < 500 mg of this tetraamineplatinum(II) chloride hydrate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tetraamineplatinum(II) chloride hydrate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetraamineplatinum(II) chloride hydrate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of Pd nanoparticle

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Weigh 0.050 g of tetraamineplatinum chloride hydrate.
3. Bring the solid into the fume hood, and add the reagent into a round bottom flask.
4. After reaction, the removed solvent needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name

 Signature

Approval Date: 02/01/2013, updated 03/01/2014

Tetradecyltrimethylammonium bromide

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetradecyltrimethylammonium bromide (C₁₇H₃₈BrN, CAS No. 1119-97-7) is used in laboratory. Its purpose is not to have any accident or risk. Tetradecyltrimethylammonium bromide is corrosive solid. It causes skin burns and eye burns. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. Also, It may be harmful if inhaled, if absorbed through skin, or if swallowed.

Synonyms: Myristyltrimethylammonium bromide, Trimethyl(tetradecyl)ammonium bromide

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Corrosive

GHS Classification

Acute toxicity, Oral (Category 5)

Skin corrosion (Category 1B)

Serious eye damage (Category 1)

Signs and Symptoms of Exposure

Cough, Shortness of breath, Headache, Nausea, Vomiting.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Small** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetradecyltrimethylammonium bromide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetradecyltrimethylammonium bromide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetradecyltrimethylammonium bromide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetradecyltrimethylammonium bromide and understand the hazards.

Lab workers using tetradecyltrimethylammonium bromide must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetradecyltrimethylammonium bromide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;

- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 25 g of this tetradecyltrimethylammonium bromide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tetradecyltrimethylammonium bromide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetradecyltrimethylammonium bromide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Pt Nanoparticle Preparation

1. Wear dust respirator, gloves, flame-resistant lab coat, and safety goggles.
2. Bring tetradecyltrimethylammonium bromide bottle to the balance. Use a nickel spoon to transfer tetradecyltrimethylammonium bromide into the designated vessel quickly.
3. Close and seal the bottle and put it back.
4. Discard extra tetradecyltrimethylammonium bromide to designated chemical waste container. Clean the balance with brush.
5. Take tetradecyltrimethylammonium bromide to fume hood. Add designated amount of solvent to dissolve polyvinylpyrrolidone. Mix with Pt precursor and reduce the solution under designated conditions.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 06/01/2013, updated 07/02

Tetraethyl orthosilicate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetraethyl orthosilicate (C₈H₂₀O₄Si, CAS No. 78-10-4) are used in laboratory. Its purpose is not to have any accident or risk. Tetraethyl orthosilicate causes serious eye irritation and is harmful if inhaled. Tetraethyl orthosilicate is commercially available, and used mostly for silica preparation in Zaera group. A variety of inorganic solvents are used to clean sample containers.

Synonyms: Tetraethoxysilane, Orthosilicic acid tetraethyl ester

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Combustible Liquid, Target Organ Effect (Liver, Kidney, Lungs, Blood, and Eye), Irritant

GHS Classification

- Flammable liquids (Category 3)
- Acute toxicity, Inhalation (Category 4)
- Skin irritation (Category 2)
- Eye irritation (Category 2A)
- Specific target organ toxicity - single exposure (Category 3)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- ***Small*** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetraethyl orthosilicate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetraethyl orthosilicate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetraethyl orthosilicate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetraethyl orthosilicate and understand the hazards.

Lab workers using tetraethyl orthosilicate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetraethyl orthosilicate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;

- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this tetraethyl orthosilicate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tetraethyl orthosilicate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetraethyl orthosilicate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Silica Preparation 1

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Take tetraethyl orthosilicate out of the fridge and bring the bottle to the balance.
3. Transfer designated amount of tetraethyl orthosilicate into the vessel.
4. Close and seal the bottle and put it back to the fridge.
5. Mix tetraethyl orthosilicate with other designated reagents.
6. Stir and dry under designated conditions.
7. Extra unused reagents need to be treated as hazardous waste.

Silica particle preparation

1. Wear nitrile chemical-resistant glove, mask, flame-resistant lab coat, and safety goggles.
2. Take tetraethyl orthosilicate (1 mL) by a syringe in a fume hood.
3. Bring an ethanol into the fume hood and injecting the syringe into the ethanol.

Synthesis of silica spheres

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of tetraethyl orthosilicate, ethanol, and ammonium hydroxide again; especially remind first aid measures, handling and storage, & PPE.*
3. Place an Erlenmeyer flask into a fume hood and put a stir bar into it.

4. Add ethanol (72 mL) and milli-Q water (12 mL) to the flask and close with rubber septum. Stir for 5 minutes.
5. Take the bottle of ammonium hydroxide from a corrosive base cabinet and place it into the fume hood. Remove the septum from the flask and add ammonium hydroxide (1.95 mL) by using a micropipette. Stir for 5 minutes.
6. Take tetraethyl orthosilicate (TEOS) from the flammable cabinet and put it into the fume hood. Add TEOS (2.55 mL) to the mixture.
7. Stir for 4 hours at room temperature.
8. Centrifuge and dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.
9. Label the centrifuge tube appropriately, cover it with perforated aluminum foil and dry the powder in a vacuum desiccator overnight.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014, 10/01/2014, 05/15/2016

Tetrahydrofuran

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetrahydrofuran (C₄H₈O, CAS No. 109-99-9) used in laboratory. Its purpose is not to have any accident or risk. Tetrahydrofuran is flammable liquid and vapor and harmful if swallowed or in contact with skin. It causes serious eye and mild skin irritation. Also it may cause drowsiness and dizziness.

Synonyms: THF

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Flammable liquid, Target organ effect (Central nervous system, Liver and Kidney), Harmful by Ingestion, Irritant, Carcinogen

GHS Classification

- Flammable liquids (Category 2)
- Acute toxicity, Oral (Category 4)
- Acute toxicity, Dermal (Category 5)
- Skin irritation (Category 3)
- Serious eye damage (Category 1)
- Specific target organ toxicity - single exposure (Category 3)

Signs and Symptoms of Exposure

Central nervous system depression, Cough, chest pain, Difficulty in breathing, Exposure to high airborne concentrations can cause anesthetic effects. To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be

buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.

- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetrahydrofuran must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetrahydrofuran.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetrahydrofuran must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetrahydrofuran and understand the hazards.

Lab workers using tetrahydrofuran must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetrahydrofuran described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this tetrahydrofuran in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tetrahydrofuran with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetrahydrofuran. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of Cd-TEOSPC

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Take tetrahydrofuran (20 mL) as solvent for the reaction into the two-neck round bottom flask in the fume hood.
3. After reaction, the filtrate needs to be treated as hazardous waste.
4. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name

 Signature

Approval Date: 02/01/2013, updated 03/01/2014

Tetrakis(dimethylamido)titanium

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetrakis(dimethylamido)titanium (C₈H₂₄N₄Ti, CAS No. 3275-24-9) used in laboratory. Its purpose is not to have any accident or risk. Tetrakis(dimethylamido)titanium is highly flammable corrosive liquid and vapor. It causes severe skin burns and eye damage. In contact with water, it releases flammable gases which may ignite spontaneously.

Synonyms: Tetrakis(dimethylamino)titanium (IV), TDMAT

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Flammable, Corrosive,

GHS Classification

Flammable liquid (Category 2)

Skin corrosion (Category 1B)

Serious eye damage (Category 1)

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Spasm, inflammation and edema of the larynx, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Small** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetrakis(dimethylamido)titanium must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetrakis(dimethylamido)titanium.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetrakis(dimethylamido)titanium must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetrakis(dimethylamido)titanium and understand the hazards.

Lab workers using tetrakis(dimethylamido)titanium must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetrakis(dimethylamido)titanium described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;

- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 1 mL of this tetrakis(dimethylamido)titanium in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tetrakis(dimethylamido)titanium with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material, the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetrakis(dimethylamido)titanium. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Tetrakis(dimethylamido)titanium for ALD reactor

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Add tetrakis(dimethylamido)titanium (0.5 mL) into the metal-glass adaptor container in the glove box in room 135. Connect the container to a Swagelok valve and close the valve inside the glove box.
3. Connect the Swagelok valve with tetrakis(dimethylamido)titanium to the ALD reactor.
4. Tetrakis(dimethylamido)titanium is pumped by mechanical pump. Use a freeze-thaw cycle if necessary.
5. Use tetrakis(dimethylamido)titanium at room temperature.
6. In the ALD reaction, slowly open the Swagelok valve to reach the desired vapor pressure and expose for a certain amount of time (5 s). Close the valve and purge the line with inert nitrogen gas.

SOP Reviewed and Approved by:

 Francisco Zaera
 Print name

 Signature

Approval Date: 11/01/2015

Tetrakis(hydroxymethyl)phosphonium chloride

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetrakis(hydroxymethyl)phosphonium chloride (C₄H₁₂ClO₄ P, CAS No. 124-64-1) is used in laboratory. Its purpose is not to have any accident or risk. Tetrakis(hydroxymethyl)phosphonium chloride is corrosive toxic liquid. It is harmful if inhaled or swallowed. Also, it causes severe skin irritation and eye damage.

Synonyms: THPC

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Corrosive, Toxic by Inhalation and Ingestion, Skin Absorption

GHS Classification

- Acute toxicity, Oral (Category 3)
- Acute toxicity, Dermal (Category 3)
- Skin irritation (Category 2)
- Serious eye damage (Category 1)
- Respiratory sensitization (Category 1)
- Acute aquatic toxicity (Category 2)

Signs and Symptoms of Exposure

Stomach - Irregularities - Based on Human Evidence

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Small** – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetrakis(hydroxymethyl)phosphonium chloride must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetrakis(hydroxymethyl)phosphonium chloride.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetrakis(hydroxymethyl)phosphonium chloride must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetrakis(hydroxymethyl)phosphonium chloride and understand the hazards.

Lab workers using tetrakis(hydroxymethyl)phosphonium chloride must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetrakis(hydroxymethyl)phosphonium chloride described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;

- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 mL of this tetrakis(hydroxymethyl)phosphonium chloride in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tetrakis(hydroxymethyl) phosphonium chloride with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetrakis(hydroxymethyl)phosphonium chloride. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Au Nanoparticle (2 nm) Preparation

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. In a round-bottom flask, Milli-Q water (45.5 mL), NaOH (0.2 M, 1.5 mL), tetrakis(hydroxymethyl)phosphonium chloride (1 mL, 120 μ L diluted in 10 mL) are added in sequence.
3. The mixture is stirred for 2 min
4. Chloroauric acid solution (25 mM, 2 mL) is added.
5. The colloidal nanoparticle suspension is further stirred for 2 min
6. The suspension is stored in a plastic centrifuge tube in dark at room temperature.
7. Clean the reaction vessel with aqua regia after reaction.

Preparation of gold nanoparticles

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of gold chloride trihydrate, sodium hydroxide, and Tetrakis(hydroxymethyl)phosphonium chloride again; especially remind first aid measures, handling and storage, & PPE.*
3. Place a very clean one neck round bottom flask into a fume hood and put a stir bar into it.

4. Take gold chloride trihydrate from inorganic acid cabinet and take it to a balance. Weigh it (157.6 mg) and add it into a centrifuge tube. Close the centrifuge tube and transfer it to the fume hood. Add milli-Q water (20 mL) to the centrifuge tube.
5. Add milli-Q water (364 mL) to the round-bottom flask.
6. Take sodium hydroxide solution (0.2 M) from a corrosive base cabinet and place it into the fume hood. Add water (12 mL) in the round-bottom flask.
7. Separately in a centrifuge tube prepare a solution of tetrakis(hydroxymethyl) phosphonium chloride in water. First take the bottle of tetrakis(hydroxymethyl) phosphonium chloride from the flammable cabinet and place it into the fume hood. Add milli-Q water (8 mL) into the centrifuge tube. Next, add tetrakis (hydroxymethyl)phosphonium chloride (96 μ L) into it. Stir and add the mixture to the round bottom flask.
8. Stir the mixture in the closed round-bottom flask for 2 minutes. Then, add the mixture of gold chloride trihydrate and water and stir for another 2 minutes.
9. Save the gold solution in appropriately labeled centrifuge tubes.
10. When using the gold solution, dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 10/01/2014, updated 03/01/2016, 05/15/2016

Tetramethyl orthosilicate

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetramethyl orthosilicate (C₄H₁₂O₄Si, CAS No. 681-84-5) are used in laboratory. Its purpose is not to have any accident or risk. Tetramethyl orthosilicate causes serious eye damage and is fatal if inhaled. Tetramethyl orthosilicate is commercially available, and used mostly for silica preparation in Zaera group. A variety of inorganic solvents are used to clean sample containers.

Synonyms: Tetramethoxysilane, Orthosilicic acid tetramethyl ester

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Combustible Liquid, Target Organ Effect (Liver, Kidney, Lungs, Blood, and Eye), Toxic, Irritant

GHS Classification

- Flammable liquids (Category 3)
- Acute toxicity, Inhalation (Category 1)
- Skin irritation (Category 2)
- Serious eye damage (Category 1)
- Specific target organ toxicity - single exposure (Category 3)

Signs and Symptoms of Exposure

Blindness, Effects due to ingestion may include: Nausea, Vomiting, Gastrointestina disturbance, Dizziness, Difficulty in breathing, Weakness, Drowsiness, and Unconsciousness

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be

buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.

- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetramethyl orthosilicate must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetramethyl orthosilicate.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetramethyl orthosilicate must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetramethyl orthosilicate and understand the hazards.

Lab workers using tetramethyl orthosilicate must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetramethyl orthosilicate described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines factors) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this tetramethyl orthosilicate in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this tetramethyl orthosilicate with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetramethyl orthosilicate. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

ALD Operation

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Take tetramethyl orthosilicate (1 g) into a 2 mL glass sample tube in the fume hood of room 162.
3. Fix the tube on the homemade ALD reactor in room 143.
4. Open the valve to introduce tetramethyl orthosilicate into the ALD chamber for 30 s, and then purge with N₂ for 120 s.
5. After reaction, close the valve and keep the residual reagent in glass tube for the next reaction.
6. Washing and cleaning solvents also need to be treated as hazardous waste.

Reaction

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggle.
2. Pluronic[®] F-127 (1.0 g) is dissolved in HCl (2 M, 60 mL), KCl (2.5 g), and 1,3,5-trimethylbenzene (1.0 g).
3. This is stirred at room temperature for 24 hours.
4. Tetramethyl orthosilicate (4.1 g) is added drop-wise to the mixture and stirred for 24 hours.
5. The solution undergoes hydrothermal treatment at 100 °C for 48 hours, then filtered and rinsed with H₂O.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 07/01/2014, updated 03/01/2016

Tetraoctylammonium bromide

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when tetraoctylammonium bromide (C₃₂H₆₈NBr, CAS No. 14866-33-2) is used in laboratory. Its purpose is not to have any accident or risk. Tetraoctylammonium bromide causes skin and eye irritation. It may be harmful if inhaled or if swallowed.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Irritant

GHS Classification

Skin irritation (Category 2)

Eye irritation (Category 2A)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with tetraoctylammonium bromide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for tetraoctylammonium bromide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using tetraoctylammonium bromide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of tetraoctylammonium bromide and understand the hazards.

Lab workers using tetraoctylammonium bromide must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with tetraoctylammonium bromide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 5 g of this tetraoctylammonium bromide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this tetraoctylammonium bromide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using tetraoctylammonium bromide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of silica

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggle.
2. Weight 0.2 g of tetraoctylammonium bromide on the balance in room 137.
3. Bring the solid in the fume hood. Followed by adding other reagents, the reaction is conducted in a beaker with stirring.
4. After reaction, the filtrate needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014

Titanium butoxide

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when titanium butoxide (C₁₆H₃₆O₄Ti, CAS No. 5593-70-4) is used in laboratory. Its purpose is not to have any accident or risk. Titanium butoxide is flammable and causes eye, respiratory system and skin irritations.

Synonyms: Orthotitanic acid tetrabutylester, Tetrabutyl orthotitanate, Tetra *n*-butyl titanate

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Titanium(IV) butoxide is commercially available, and used mostly for TiO₂ preparation in Zaera group. A variety of organic solvents are used to clean sample containers. Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Combustible liquid, Target organ effect (Central nervous system, Lymphatic system, Ears, Kidney, Liver and blood), Harmful by ingestion, Irritant

GHS Classification

- Flammable liquids (Category 3)
- Acute toxicity, Oral (Category 5)
- Skin irritation (Category 2)
- Eye irritation (Category 2A)
- Specific target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

No data is available.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be

buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.

- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with titanium butoxide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for titanium butoxide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using titanium butoxide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of titanium butoxide and understand the hazards.

Lab workers using titanium butoxide must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with titanium butoxide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this titanium butoxide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this titanium butoxide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using titanium butoxide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

TiO₂ coating onto the silica particle 1

1. Wear nitrile chemical-resistant glove, mask, flame-resistant lab coat, and safety goggles.
2. Take titanium butoxide (1 mL) by a syringe in a fume hood.
3. Put ethanol (3 mL) into a glass vial.
4. Inject the titanium butoxide into the glass vial and stir vigorously.
5. Put a syringe needle into sharps-disposal container.

TiO₂ coating onto the silica particle 2

1. Wear nitrile chemical resistant gloves, flame-resistant lab coat, and safety goggles.
2. Add titanium butoxide (0.5 mL) via a syringe to ethanol (5 mL).
3. The titanium butoxide solution should be added drop wise into a refluxing suspension of Au coated silica particles (dispersed in absolute ethanol – water 1% mixture).
4. Rinse syringes several times with ethanol before disposal.
5. The washings should be disposed as hazardous organic waste.

Making of titania shells

1. Wear nitrile chemical-resistant gloves, mask, flame-resistant lab coat, and safety goggles.

2. *Make a waste bottle labeled as toxic and corrosive hazardous waste. Review the SDS of acetonitrile, ethanol, ammonium hydroxide, hydroxypropyl cellulose and titanium butoxide again; especially remind first aid measures, handling and storage, & PPE.*
3. Place an Erlenmeyer flask into a fume hood and put a stir bar into it. Close with a rubber septum and take it to a balance. Weigh hydroxypropyl cellulose (50 mg) and add it into the flask. Transfer the closed flask back to the fume hood.
4. Disperse silica spheres with gold nanoparticles in ethanol (21 mL) and add the dispersion to the flask.
5. With a micropipette add acetonitrile (7 mL) and close with the septum. Stir for 20 minutes.
6. Take the bottle of ammonium hydroxide from a corrosive base cabinet and place it into the fume hood. Remove the septum from the flask and add ammonium hydroxide (0.2 mL) by using a micropipette. Stir for 20 minutes.
7. Take titanium butoxide from the flammable cabinet and put it into the fume hood. Add ethanol (3 mL), acetonitrile (1 mL), and titanium butoxide into a vial and be careful not to expose titanium butoxide to air. Mix the vial well and add the mixture slowly into the main mixture. Stir for 2 hours.
8. Wash the mixture with ethanol 4 times.
9. *Dispose the waste into the waste bottle labeled toxic and corrosive hazardous waste.*

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014, 10/01/2014, 03/03/2016, 05/15/2016

Titanium (IV) dioxide

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when titanium (IV) dioxide (TiO₂, CAS No. 1317-70-0 for Anatase, 1317-80-2 for Rutile) is used in laboratory. Its purpose is not to have any accident or risk. Especially titanium dioxide is toxic by inhalation and also carcinogen. It may be harmful if absorbed through skin or swallowed, and cause skin and eye irritation. TiO₂ is commercially available and also produced from the preparation of titania-based catalysts in Zaera group. Please refer its MSDS always before using them.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Titanium dioxide is or contains a component that is not classifiable as to its carcinogenicity based on IARC, OSHA, or EPA classification.

IARC: 2B – Group 2B: Possibly carcinogenic to humans (Anatase TiO₂)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with titanium (IV) dioxide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for titanium (IV) dioxide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using titanium (IV) dioxide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of titanium (IV) dioxide and understand the hazards.

Lab workers using titanium (IV) dioxide must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with titanium (IV) dioxide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines factors) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of titanium (IV) dioxide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this titanium (IV) dioxide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using titanium (IV) dioxide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Photocatalytic reaction

1. Wear nitrile chemical-resistant glove, mask, flame-resistant lab coat, and safety goggles.
2. Weigh 5 mg of titanium dioxide and put it into the photo reactor.
3. Inject Milli Q water (50 mL) into the reactor and stir vigorously.

Catalyst preparation

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of titanium dioxide P25 again; especially remind first aid measures, handling and storage, & PPE.*
3. Take a round-bottom flask and titanium dioxide P25 to a balance. Weigh P25-TiO₂ (200 mg) and add it into the flask. Close the flask with a rubber septum and take it into a fume hood.
4. Put a stir bar into the round-bottom flask. Add Au colloidal suspension (10 mL) using a micropipette.
5. Stir for 4 hours at room temperature. Centrifuge and pour water into the waste bottle.
6. Label the centrifuge tube appropriately, cover it with perforated aluminum foil and dry the powder in a vacuum desiccator overnight.

Functionalization of P25 titania nanoparticles

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of 3-aminopropyltriethoxysilane, toluene, and P25 titania again; especially remind first aid measures, handling and storage, & PPE.*

3. Place a three-neck round-bottom flask into a fume hood and put a stir bar into it. Close with rubber septum and take it to a balance. Weigh titania powder (1 g) and add it into the round-bottom flask. Closed with septum and take it back to the fume hood.
4. Add toluene (50 mL), close with the septum and sonicate for about 1 minute so that the solid disperse well in the solvent.
5. Take the closed round-bottom flask to the fume hood in the room 162. Attach it to a condenser and close the other two necks with a rubber septum. Put a thermometer probe through one septum into the mixture. Don't forget to open water running through condenser. Change the atmosphere inside the round-bottom flask to nitrogen and set the temperature to 113 °C.
6. Take 3-aminopropyltriethoxysilane from the flammable cabinet and put it into the fume hood. Add the compound (1.5 mL) into the mixture when it starts boiling.
7. Leave the reaction running for 1 day.
8. When the functionalization has finished, remove the condenser and close the middle neck of the round-bottom flask with septum. Bring it into the fume hood in the room 135. Wait for it to cool down and then wash it with ethanol 4 times.
9. **Dispose the waste into the waste bottle labeled toxic hazardous waste.**

Silylation of P25 titania

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of 1-(trimethylsilyl)imidazole, toluene, and P25 titania again; especially remind first aid measures, handling and storage, & PPE.*
3. Place a three-neck round-bottom flask into a fume hood and put a stir bar into it. Close with rubber septum and take it to a balance. Weigh P25 titania powder (639 mg) and add it into the round-bottom flask. Closed with septum and take it back to the fume hood.
4. Add toluene (16 mL), close with the septum and sonicate for about 1 minute so that the solid disperse well in the solvent.
5. Take the closed round-bottom flask to the fume hood in the room 162. Attach it to a condenser and close the other two necks with a rubber septum. Put a thermometer probe through one septum into the mixture. Don't forget to open water running through condenser. Change the atmosphere inside the round-bottom flask to nitrogen and set the temperature to 113 °C.
6. Take 1-(trimethylsilyl)imidazole from the flammable cabinet and put it into the fume hood. Add the compound (2.2 mL) into the mixture when it starts boiling.
7. Leave the reaction running for 1 day.

8. When the silylation has finished, remove the condenser and close the middle neck of the round-bottom flask with septum. Bring it into the fume hood in the room 135. Wait for it to cool down and then wash it with toluene 3 times.
9. Dispose the waste into the waste bottle labeled toxic hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 06/01/2015, 05/15/2016

Toluene

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when toluene (C₇H₈, CAS No. 108-88-3) used in laboratory. Its purpose is not to have any accident or risk. Toluene is highly flammable liquid and vapor, and causes serious eye and skin irritation. It is harmful and suspected of damaging fertility or the unborn child. It may be fatal if swallowed and enters airways, and cause drowsiness or dizziness, damage to organs. It is also toxic to aquatic life.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Flammable liquid, Target organ effect (Bladder, Liver, Kidney and Brain), Irritant, **Teratogen**, Reproductive hazard.

GHS Classification

- Flammable liquids (Category 2)
- Acute toxicity, Inhalation (Category 4)
- Skin irritation (Category 2)
- Eye irritation (Category 2A)
- Reproductive toxicity (Category 2)
- Specific target organ toxicity - single exposure (Category 2,3)
- Aspiration hazard (Category 1)
- Acute aquatic toxicity (Category 2)

Signs and Symptoms of Exposure

Lung irritation, chest pain, pulmonary edema, Inhalation studies on toluene have demonstrated the development of inflammatory and ulcerous lesions of the penis, prepuce, and scrotum in animals.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be

buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.

- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with toluene must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for toluene.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using toluene must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of toluene and understand the hazards.

Lab workers using toluene must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with toluene described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;

- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this toluene in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this toluene with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using toluene. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Hydrogenation of ethyl pyruvate

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Take 6 mL of toluene into the high-pressure reactor in the fume hood.
3. Add catalyst and substrate into the reactor, and then the reaction is conducted in the corresponding instrument in room 135.
4. After reaction, the filtrate needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

Si wafer washing

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Bring the toluene solution bottle to the fume hood.
3. Load this Toluene solution into spray bottle for washing purpose afterwards
4. After washing the Si wafer, the sample solution needs to be treated as hazardous

Synthesis of 1,1'-(1,2-Dioxoethane-1,2-diyl)bis-1*H*-benzotriazole

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Dry a flask (500 mL) and a dropping funnel under nitrogen.
3. Put benzotriazole (11.9 g, 100 mmol) into the flask.
4. Add ether (400 mL) into the flask.
5. Put toluene (40 mL) and oxalyl chloride (6.35 g, 50 mmol) into the dropping funnel.
6. Drop the oxalyl chloride solution slowly into the flask.

7. Stir the mixture for 20 h at room temperature. If you leave it unattended in a fume hood, put a label with chemical name and hazard information.
8. Filter and wash the mixture with ether.
9. Dry the white powder.

Catalytic Oxidation Reaction

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Into the test tube with stir bar, add a heterogeneous catalyst (9 mg) and potassium carbonate (27 mg), and toluene (4.5 mL).
3. Ultrasonicate and stir the mixture.
4. Add a chemical to be oxidized (0.05 mmol; e.g. benzyl alcohol, fluorene, p-Cymene, etc.).
5. Close with a rubber septum, seal with parafilm, connect the oxygen supply to the test tube, and do the catalytic reaction at temperatures below 75 °C (boiling point of benzene is 80.1 °C).
6. Collect the samples.
7. Run GC.

Oxidation of 1-Methyl-1-cyclohexene

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Into the test tube with stirring bar add P25-TiO₂/Au catalyst (9 mg) and potassium tert-butoxide (13 mg).
3. Add toluene (4.5 mL), ultrasonicate and stir.
4. Add benzene (12.5 μL, internal standard)
5. Add 1-methyl-1-cyclohexene (4.8 mg, 0.05 mmol).
6. Close with rubber septum, seal with parafilm, connect the oxygen supply to the test tube and do the catalytic reaction at temperature below 75 °C.
7. Collect the samples and run on GC.

Oxidation of α-Pinene

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Into the test tube with stirring bar add P25-TiO₂/Au catalyst (9 mg) and potassium tert-butoxide (13 mg).
3. Add toluene (4.5 mL), ultrasonicate and stir.
4. Add benzene (12.5 μL, internal standard)
5. Add α-pinene (6.8 mg, 0.05 mmol).
6. Close with rubber septum, seal with parafilm, connect the oxygen supply to the test

- tube and do the catalytic reaction at temperature below 75 °C.
7. Collect the samples and run on GC.

Oxidation of Cyclooctane

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Into the test tube with stirring bar add P25-TiO₂/Au catalyst (9 mg) and potassium tert-butoxide (13 mg).
3. Add toluene (4.5 mL), ultrasonicate and stir.
4. Add benzene (12.5 μL, internal standard)
5. Add cyclooctane (5.6 mg, 0.05 mmol).
6. Close with rubber septum, seal with parafilm, connect the oxygen supply to the test tube and do the catalytic reaction at temperature below 75 °C.
7. Collect the samples and run on GC.

Oxidation reaction

1. Wear nitrile chemical-resistant gloves, mask, flame-resistant lab coat, and safety goggles.
2. In a fume hood, add of aluminum isopropoxide (100 μmol) to a round-bottom flask under N₂ atmosphere.
3. Add toluene (5 mL).
4. Add benzaldehyde (500 μmol).
5. Stir for 3 h.
6. Take NMR.

Oxidation of Fluorene

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Into the test tube with stirring bar, add P25-TiO₂/Au catalyst (9 mg), potassium carbonate (27 mg), and toluene (4.5 mL)
3. Ultrasonicate and stir the mixture.
4. Add benzene (12.5 μL, internal standard).
5. Add fluorene (0.05 mmol)
6. Close with rubber septum, seal with parafilm, connect the oxygen supply to the test tube, and do the catalytic reaction at temperature below 75 °C (boiling point of benzene is 80.1 °C).
7. Collect the sample
8. Run GC.

Oxidation of p-Cymene

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. Into the test tube with stirring bar, add P25-TiO₂/Au catalyst (9 mg) and potassium carbonate (27 mg), and toluene (4.5 mL)
3. Ultrasonicate and stir the mixture.
4. Add benzene (12.5 μL, internal standard).
5. Add p-Cymene (0.05 mmol)
6. Close with rubber septum, seal with parafilm, connect the oxygen supply to the test tube, and do the catalytic reaction at temperature below 75 °C (boiling point of benzene is 80.1 °C).
7. Collect the sample
8. Run GC.

Solvent in oxidation reactions

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic and carcinogen hazardous waste. Review the SDS of toluene and benzene again; especially remind first aid measures, handling and storage, & PPE.*
3. Place a test tube into a fume hood and put a stir bar into it. Close with a rubber septum and take it to a balance. Weigh P25-TiO₂/Au catalyst (9 mg) and add it into the test tube. Add potassium carbonate (25 mg) and transfer the closed septum back to the fume hood.
4. With a micropipette add toluene (4.5 mL), close with the septum and sonicate for about 1 minute so that the solids disperse well in the solvent.
5. Bring the mixture back to the fume hood and stir it.
6. Before adding the internal standard benzene (12.5 μL) *put on a full-face respirator*. Take a bottle of benzene from the flammable cabinet and place it into the fume hood. *Be careful not to spill benzene. Keep watching any leak of benzene. Avoid release to the environment. Avoid breathing fume, gas, mist, vapor or spray. If swallowed, immediately call 911. If inhaled, rinse cautiously with water for 15 min. Remove contact lenses, if present and easy to do. Continue rinsing.*
7. Remove the septum from the test tube and open the benzene bottle. Add the small amount of benzene into the test tube by using a Hamilton syringe (50 μL). Wash the syringe with benzene three times before adding it into the reaction mixture. After adding it clean the syringe by washing it with ether. *Dispose the waste into the waste bottle labeled carcinogen hazardous waste.* Once adding

benzene the handling of the reaction mixture has to be carried out with the **full-face respirator on**.

8. Put the benzene bottle back to the flammable cabinet. *Be careful not to spill benzene. Keep watching any leak of benzene. Avoid release to the environment. Avoid breathing fume, gas, mist, vapor or spray. If swallowed, immediately call 911. If inhaled, rinse cautiously with water for 15 min. Remove contact lenses, if present and easy to do. Continue rinsing.*
9. Take the reactant (e.g. benzyl alcohol, p-cymene, fluorene, etc.) from the flammable cabinet and put it into the fume hood. Add the reactant (5.5 μL) into the reaction mixture.
10. Close the test tube with the rubber septum, seal with Teflon tape and connect the oxygen supply to the test tube.
11. Open the main valve of oxygen cylinder, which is located in a cupboard in a corridor in front of the room 135. After then, open the oxygen Swagelok needle valve in the fume hood, and fill the balloon with oxygen. Attach the balloon to a needle going through the rubber septum into the reaction mixture.
12. Transfer the test tube into the oil bath and do the catalytic reaction at temperature below 75 $^{\circ}\text{C}$ (boiling point of benzene is 80.1 $^{\circ}\text{C}$).
13. Collect samples at different reaction times and remember to always **put on the full-face respirator** before working with the mixture. Put a sample (100 μL) into a small centrifuge tube and centrifuge it to remove the solids.
14. After centrifuging bring the closed vial back to the fume hood and transfer the liquid into a new vial.
15. Inject the sample into GC using a Hamilton syringe (10 μL).
16. Dispose all the waste into the appropriately labeled waste bottle.

Functionalization of silica nanospheres or P25 titania nanoparticles

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of 3-aminopropyltriethoxysilane, toluene, and P25 titania again; especially remind first aid measures, handling and storage, & PPE.*
3. Place a three-neck round-bottom flask into a fume hood and put a stir bar into it. Close with rubber septum and take it to a balance. Weigh silica or titania powder (1 g) and add it into the round-bottom flask. Closed with septum and take it back to the fume hood.
4. Add toluene (50 mL), close with the septum and sonicate for about 1 minute so that the solid disperse well in the solvent.
5. Take the closed round-bottom flask to the fume hood in the room 162. Attach it to a condenser and close the other two necks with a rubber septum. Put a thermometer probe through one septum into the mixture. Don't forget to open

water running through condenser. Change the atmosphere inside the round-bottom flask to nitrogen and set the temperature to 113 °C.

6. Take 3-aminopropyltriethoxysilane from the flammable cabinet and put it into the fume hood. Add the compound (1.5 mL) into the mixture when it starts boiling.
7. Leave the reaction running for 1 day.
8. When the functionalization has finished, remove the condenser and close the middle neck of the round-bottom flask with septum. Bring it into the fume hood in the room 135. Wait for it to cool down and then wash it with ethanol 4 times.
9. **Dispose the waste into the waste bottle labeled toxic hazardous waste.**

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014, 03/03/2016, 05/15/2016

Toluene-d₈ STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when toluene-d₈ (C₇D₈, CAS No. 2037-26-5) used in laboratory. Its purpose is not to have any accident or risk. Toluene-d₈ is highly flammable liquid and vapor, and causes serious eye and skin irritation. It is harmful and suspected of damaging fertility or the unborn child. It may be fatal if swallowed and enters airways, and cause drowsiness or dizziness, damage to organs. It is also toxic to aquatic life.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Flammable liquid, Target organ effect (Bladder, Liver, Kidney and Brain), Irritant, **Teratogen**, Reproductive hazard.

GHS Classification

- Flammable liquids (Category 2)
- Acute toxicity, Inhalation (Category 4)
- Skin irritation (Category 2)
- Eye irritation (Category 2A)
- Reproductive toxicity (Category 2)
- Specific target organ toxicity - single exposure (Category 2,3)
- Aspiration hazard (Category 1)
- Acute aquatic toxicity (Category 2)

Signs and Symptoms of Exposure

Lung irritation, chest pain, pulmonary edema, Inhalation studies on toluene have demonstrated the development of inflammatory and ulcerous lesions of the penis, prepuce, and scrotum in animals.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be

buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.

- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with toluene-d₈ must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for toluene-d₈.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using toluene-d₈ must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of toluene-d₈ and understand the hazards.

Lab workers using toluene-d₈ must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with toluene-d₈ described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines factor) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;

- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 5 mL of this toluene-d₈ in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this toluene-d₈ with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using toluene-d₈. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

NMR Sample Preparation

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggle.
2. Bring the sample for NMR measurement and toluene-d₈ into a fume hood.
3. A proper amount of NMR sample is placed in a NMR tube and fill with toluene-d₈ (1 mL).
4. Bring the NMR tubes in a second container to the NMR room carefully.
5. After measurement, the sample solution needs to be treated as hazardous waste.
6. Cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 01/01/2014

trans-2-Butene

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when *trans*-2-butene (C₄H₈, CAS No. 624-64-6) used in laboratory. Its purpose is not to have any accident or risk. *trans*-2-Butene is highly flammable gas, and contains gas under pressure. It may explode if heated, and may cause drowsiness or dizziness.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Flammable gas, Compressed Gas

GHS Classification

Flammable liquids (Category 1)

Gas under pressure (Liquefied gas)

Signs and Symptoms of Exposure

May be harmful. Acts as a simple asphyxiant by displacing air. Dizziness, Disorientation, Headache, excitement, Central nervous system depression

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with *trans*-2-butene must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for *trans*-2-butene.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using *trans*-2-butene must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of *trans*-2-butene and understand the hazards.

Lab workers using *trans*-2-butene must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with *trans*-2-butene described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) use *trans*-2-butene under 1 bar in any given reaction (higher pressure REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this *trans*-2-butene with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using *trans*-2-butene. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Replace empty gas cylinder

- 1) In case of carbon monoxide, ensure carbon monoxide detector is on
- 2) Borrow a proper dolly from department stockroom.
- 3) Close the main cylinder valve.
- 4) Slowly release pressure from regulator into hood to vent.
- 5) Close the regulator valves.
- 6) Disconnect the regulator from an empty cylinder.
- 7) Screw cylinder cap.
- 8) Deliver the empty cylinder to the stockroom or store temporarily in one of hall cabinets.
- 9) Bring a new gas cylinder to the rack.
- 10) Safely secure the cylinder using chain clamp.
- 11) Unscrew cylinder cap.
- 12) Ensure the main valve is closed.
- 13) Unscrew the main valve cap.
- 14) Connect the regulator to the cylinder.
- 15) Fully open the regulator valves.
- 16) Get vacuum in the gas manifold and the regulator.
- 17) Closed the diaphragm valve.
- 18) Quickly open and close the main cylinder valve to see if the diaphragm valve is working well.
- 19) If the good sealing is obtained, go ahead. Otherwise, pump the gas in the line and replace the regulator.
- 20) Set a delivery pressure as needed.
- 21) Carefully release pressure from regulator.
- 22) Fully open the main cylinder valve if needed.

SOP Reviewed and Approved by:

 Francisco Zaera
 Print name

 Signature

Approval Date: 02/01/2013

trans-4-Hydroxy-L-proline

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when trans-4-hydroxy-L-proline ($C_5H_9NO_3$ CAS No. 51-35-4) is used in laboratory. Its purpose is not to have any accident or risk. trans-4-Hydroxy-L-proline may be harmful to aquatic life.

Synonyms: Hyp(2S,4R)-4-Hydroxypyrrolidine-2-carboxylic acid

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: not known

GHS Classification

Not a dangerous substance according to GHS

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with trans-4-hydroxy-L-proline must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for trans-4-hydroxy-L-proline.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using trans-4-hydroxy-L-proline must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of trans-4-hydroxy-L-proline and understand the hazards.

Lab workers using trans-4-hydroxy-L-proline must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with trans-4-hydroxy-L-proline described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this trans-4-hydroxy-L-proline in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this trans-4-hydroxy-L-proline with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using trans-4-hydroxy-L-proline. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Reaction

1. SiO₂-Cl is suspended in xylene (20 mL) at 140 °C under nitrogen atmosphere and stirred for 1 h.
2. Trans-4-hydroxy-L-Proline (0.026 g) is added to the mixture at the same temperature under nitrogen atmosphere for 12 h.
3. The solid is rinsed and washed with ethanol and water and dried at 120 °C for 12 h, resulting in SiO₂-Proline

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 06/01/2015, updated 03/01/2016

trans-Chalcone

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when **trans-chalcone** ($C_{15}H_{12}O$, CAS No. 614-47-1) used in laboratory. Its purpose is not to have any accident or risk. **trans-Chalcone** is toxic if swallowed. Also it is harmful if inhaled.

Synonyms: **Benzylideneacetophenone**

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: **Toxic by Ingestion, Irritant**

GHS Classification

Acute toxicity, Oral (Category 4)

Eye irritation (Category 2A)

Specific target organ toxicity – single exposure (Category 3)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with trans-chalcone must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for trans-chalcone.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using trans-chalcone must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of trans-chalcone and understand the hazards.

Lab workers using trans-chalcone must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with trans-chalcone described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 5 g of this trans-chalcone in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this trans-chalcone with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using trans-chalcone. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Check the position of GC-peak

1. Wear nitrile chemical-resistant gloves, flame-resistant lab coat, and safety goggles.
2. *Make a waste bottle labeled as toxic hazardous waste. Review the SDS of trans-Chalcone again; especially remind first aid measures, handling and storage, & PPE.*
3. Take trans-chalcone from the solid cabinet to a balance. Weigh 5 mg of trans-chalcone (5 mg) and add it into a vial. Transfer the closed vial to the fume hood.
4. With a micropipette add toluene (2 mL), close the vial and sonicate for about 1 minute so that the solid disperse well in the solvent.
5. Inject the sample into GC using a Hamilton syringe (10 μ L).

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 05/01/2016

Trichloroethylene

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when trichloroethylene (C₂HCl₃, CAS No. 79-01-6) is used in laboratory. Its purpose is not to have any accident or risk. Especially trichloroethylene is a **CAL/OHSA Select Carcinogen and mutagen and had mutagen hazard**, so may cause cancer, damage to organ and heritable genetic damage. Also, it causes serious eye and skin inhalation. It may be harmful if swallowed.

Synonyms: TCE, Trichloroethene

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Select Carcinogen

The OSHA Lab Standard defines a "Select Carcinogen" as any substance, which meets one of the following criteria:

- (i) It is regulated by OSHA as a carcinogen; or
- (ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP); or
- (iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC); or
- (iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
 - (A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m;
 - (B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or
 - (C) After oral dosages of less than 50 mg/kg of body weight per day.

OSHA Hazards: Carcinogen, Target Organ Effect (Liver, Central nervous system, Hear, Lungs), Irritant, Mutagen

GHS Classification

- Acute toxicity, Oral (Category 5)
- Skin irritation (Category 2)
- Eye irritation (Category 2A)
- Germ cell mutagenicity (Category 2)
- Carcinogenicity (Category 1B)
- Specific target organ toxicity – repeated exposure (Category 2)

Acute aquatic toxicity (Category 3)
Chronic aquatic toxicity (Category 3)

Signs and Symptoms of Exposure

Burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Exposure to and/or consumption of alcohol may increase toxic effects., Gastrointestinal disturbance, Kidney injury may occur., narcosis

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-line hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with trichloroethylene must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for trichloroethylene.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using trichloroethylene must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of trichloroethylene and understand the hazards.

Lab workers using trichloroethylene must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with trichloroethylene described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 100 mL of this trichloroethylene in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this trichloroethylene with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using trichloroethylene. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013

Triisobutylaluminum

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when triisobutylaluminum (C₁₂H₂₇Al, CAS No. 100-99-2) used in laboratory. Its purpose is not to have any accident or risk. Triisobutylaluminum is highly flammable corrosive liquid (pyrophoric) and vapor. It causes eye burns and skin burns. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. Also, it may be harmful if swallowed, if inhaled, or if absorbed through skin.

Synonyms: Aluminum triisobutanide

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Pyrophoric materials ignite spontaneously when exposed to air. They also tend to be associated with flammable solvents. Other common hazards include corrosivity, water reactivity, peroxide formation, toxicity, and damage to the liver, kidneys, and central nervous system. BEFORE working with pyrophoric reagents, read the relevant Material Safety Data Sheets (MSDS) and understand the hazards. The MSDS must be reviewed before using an unfamiliar chemical and periodically as a reminder. Set up your work in a laboratory fume hood or glove box and ALWAYS wear the appropriate PPE.

OSHA Hazards: Flammable Liquid, Corrosive, **Pyrophoric**

GHS Classification

- Pyrophoric liquids (Category 1)
- Substances, which in contact with water, emit flammable gases (Category 2)
- Skin corrosion (Category 1B)
- Serious eye damage (Category 1)

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Cough, Shortness of breath, Headache, Nausea

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

- Chemical Splash goggles or safety glasses that meet the ANSI Z.87.1-1989 standard must be worn whenever handling pyrophoric chemicals. Ordinary prescription glasses will NOT provide adequate protection unless they also meet the standard. When there is the potential for splashes, goggles must be worn, and when appropriate, a face shield added.

- A face shield is required any time there is a risk of explosion, large splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals with pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

b. Skin and Body Protection

- Use adequate protection to prevent skin exposures.
- A flame-resistant lab coat must be worn.
- A chemical-resistant apron worn over the lab coat is required for working with large quantities.
- No open-toe shoes are allowed.

c. Hand Protection

- Hand protection requirements for the use of solid pyrophoric chemicals outside an inerted glove box include wearing/donning the appropriate chemical resistant out gloves (Neoprene) and fire resistant (FR) inner gloves/liners.
- Gloves or glove liners composed of the tight weave, inherently flame resistant materials Kevlar[®], Nomex[®], Kerinel[®], or PBI[®], or a blend of those materials, of sufficient thickness to prevent or minimize burn injuries to the extent feasible. Gloves or glove liners meeting MIL-DTL-81188C are also acceptable.
- Acceptable glove liners include the followings:
 - ✓ Ansell Kevlar[®] Goldknit[®] Lightweight 70-200,
 - ✓ Hanz Extremity Wear Nomex[®] Utility 2257C and 2259C,
 - ✓ Other Kevlar[®] gloves with the fabric basis weight of a minimum of 7.7 ounces per square yard and if one layer of the material has a minimum of 35 mils in thickness, and
 - ✓ Other Nomex[®] gloves meeting the specifications for Hans Extremity Wear Nomex[®] Utility 2257G and 2259C.
- Laboratories must have these gloves available and use them for this specific research activity. This requirement may not be superseded by reference to a Safety Data Sheet (SDS).

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store pyrophoric chemicals under an inert atmosphere or under kerosene as appropriate. Avoid areas with heat/flames, oxidizers, and water resource. Containers carrying pyrophoric materials must be clearly labeled with the correct chemical name and hazard warning. Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Spill - Small

- Exert extreme caution due to potential spontaneous combustion
- Exert extreme caution due to ignition of flammable solvents or other materials.
- If anyone is exposed, or on fire, wash with copious amount of water, ideally in the lab shower.
- Call for co-worker to provide backup.
- Place a fire extinguisher nearby.
- Carefully remove nearby flammable materials.
- Powdered lime (calcium oxide, CaO) or dry sand should be used to completely smother and cover any spill that occurs.
- After complete quench, double bag spill residues for hazardous waste pickup.
- Call 911 for emergency assistance if necessary.

Spill - Large

- Exert extreme caution due to potential spontaneous combustion.
- Exert extreme caution due to potential ignition of flammable solvent or other materials.
- If anyone is exposed, or on fire, wash with copious amounts of water, ideally in the lab shower.
- Call 911 or EH&S at 951-827-5528 for emergency assistance.
- Evacuate the spill area
- Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering.
- Provide emergency personnel with technical advice on the chemical involved.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Small amounts of unused or unwanted pyrophoric materials must be destroyed by careful quenching of the residue. Transfer the materials to an appropriate reaction flask for hydrolysis and/or neutralization. Dilute significantly with an unreactive solvent such as heptane or toluene and place the flask in an ice water cooling bath. Slowly add isopropanol to quench pyrophoric materials. Upon completion, add Methanol as a more reactive quenching agent to ensure completion. Finally, add water dropwise to make sure there are no pockets of reactive materials. Dispose of as hazardous waste.

- Alternatively, reactive substances can be quenched by slowly adding the dilute solution to dry ice, then adding a mildly reactive quenching agent such as methanol.
- AVOID low boiling diluents such as ether and pentane that tend to condense water upon evaporation.
- Do not leave containers with residues of pyrophoric materials open to the atmosphere due to uncontrolled ignition.
- Affix an on-line hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with triisobutylaluminum must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED WORK AREA

a. Eyewash

- Suitable facilities for quick drenching or flushing of the eyes should be within 10 seconds travel time for immediate emergency use. Bottle type eyewash stations are not acceptable.

b. Safety Shower

- A safety or drench shower should be available within 10 seconds travel time where pyrophoric chemical are used.

c. Fume Hood

- Gloves must be worn when handling pyrophoric chemicals. Nitrile gloves should be adequate for handling most of these in general laboratory settings, but they are combustible. Heavy gloves are required for work with large quantities. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

d. Fire Extinguisher

- A Class C dry chemical fire extinguisher must be available within 10 seconds travel time from where pyrophoric chemicals are used.
- Know the location of the nearest Class D fire extinguisher.
- A container of powdered lime (calcium oxide, CaO) or dry sand should be kept within arm's length when working with a pyrophoric material.

e. Batch Reactor with Rotary Pump

- Trimethylaluminum can only be used when it is connected to a well-pumped reactor. The reactor must be leak free.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using triisobutylaluminum must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of triisobutylaluminum and understand the hazards.

Lab workers using triisobutylaluminum must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with triisobutylaluminum described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 mL of this triisobutylaluminum any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this triisobutylaluminum with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using triisobutylaluminum. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

ALD reactor

Working with triisobutylaluminum is not allowed when alone in the Lab. Prior to starting the reaction, locate the powdered lime (calcium oxide, CaO) or dry sand, fire extinguisher, eyewash and safety shower.

In Zaera lab, triisobutylaluminum was used for atomic layer deposition of aluminum oxide, but not now. Triisobutylaluminum is volatile liquid stored in stainless steel containers with a ball valve, and it is connected to the reaction chamber (reactor) by Swagelok fittings. The reactor should be pumped by a mechanical pump all the time. In our lab, triisobutylaluminum can only be used when it is connected to a well-pumped reactor. The vapor pressure is used to introduce the chemical to the reactor. Do not try to get neat aluminum alkyl liquids out from the container.

1) Wear flame-resistant outer gloves, chemical-resistant inner gloves, flame-resistant lab coat, and safety goggles.

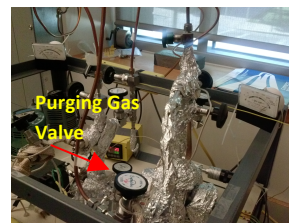
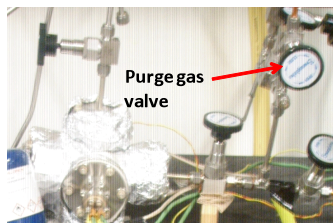
2). First, check the reactor for possible leaks. The base pressure in the reactor should around 5–10 mtorr, as read in the thermocouple gauge reader (see picture in the right). Fix the leaks before connect the triisobutylaluminum to the reactor.



3). Connect triisobutylaluminum to the reactor by Swagelok fittings. When handle triisobutylaluminum, safety glass, lab coat, and gloves should be worn. The ball valve of the metal container should be always in off position (see picture in the right) when triisobutylaluminum is not in use.



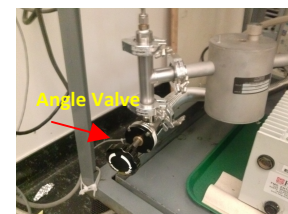
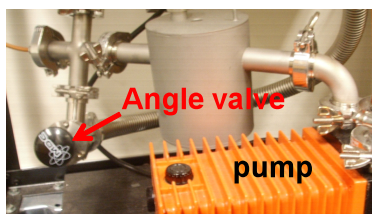
4). During the atomic layer deposition cycle, the reactor is first pumped down. Then, open the ball valve to supply triisobutylaluminum into the reactor. The exposure time varies from a second to ten seconds. Right



after triisobutylaluminum exposure, shut off the ball valve. Then immediately introduce a purging gas (Argon or Nitrogen) into the reactor for about 1 minute. Adjust the purging gas valve to maintain the pressure in the reactor around 200-500 mtorr. Do not try to backfill the triisobutylaluminum container with other gases.

5). The reactor body is normally heated to around 100 °C to minimize the water vapor inside. However, no part of the triisobutylaluminum container should be subjected to a temperature higher than 125 F (52 °C).

a) In case of power failure during the exposure experiments, please follow the steps below. Shut off the ball valve of the triisobutylaluminum immediately. Open the purging gas valve to leak purge gas into the reactor. Close the angle valve (see picture in the right) above the mechanical pump. When the power is back, make sure the mechanical pump is running. Then open the angle valve. At the same time, close the purging gas valve. The pressure in the reactor will drop.



b) The following paragraph describes the proper action to take if there is a fire.

If a fire comes out from the part between the ball valve and the container, immediately apply dry powder or fire extinguisher. Do not try to reach or remove the triisobutylaluminum container. Call for help if the fire is large.

If a fire is inside the reactor, immediately close the ball valve. Close the angle valve. Introduce the purging gas into the reactor by opening the purging gas valve.

If a fire comes out from the Swagelok fittings, immediately close the ball valve. Apply dry powder or fire extinguisher. The vacuum of the reactor and connections need to be checked.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 10/01/2013, updated 03/04/2014, 03/15/2016

Trimethylaluminum

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when trimethylaluminum (C₃H₉Al, CAS No. 75-24-1) used in laboratory. Its purpose is not to have any accident or risk. Trimethylaluminum is highly flammable corrosive liquid (pyrophoric) and vapor. It causes eye burns and skin burns. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract. Also, it may be harmful if swallowed, if inhaled, or if absorbed through skin.

Synonyms: Aluminum trimethanide

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Pyrophoric materials ignite spontaneously when exposed to air. They also tend to be associated with flammable solvents. Other common hazards include corrosivity, water reactivity, peroxide formation, toxicity, and damage to the liver, kidneys, and central nervous system. BEFORE working with pyrophoric reagents, read the relevant Material Safety Data Sheets (MSDS) and understand the hazards. The MSDS must be reviewed before using an unfamiliar chemical and periodically as a reminder. Set up your work in a laboratory fume hood or glove box and ALWAYS wear the appropriate PPE

OSHA Hazards: Flammable Liquid, Corrosive, Pyrophoric

GHS Classification

- Flammable liquids (Category 2)
- Pyrophoric liquids (Category 1)
- Skin corrosion (Category 1B)
- Serious eye damage (Category 1)

Signs and Symptoms of Exposure

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Cough, Shortness of breath, Headache, Nausea

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

- Chemical Splash goggles or safety glasses that meet the ANSI Z.87.1-1989 standard must be worn whenever handling pyrophoric chemicals. Ordinary prescription glasses will NOT provide adequate protection unless they also meet the standard. When there is the potential for splashes, goggles must be worn, and when appropriate, a face shield added.

- A face shield is required any time there is a risk of explosion, large splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals with pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

b. Skin and Body Protection

- Use adequate protection to prevent skin exposures.
- A flame-resistant lab coat must be worn.
- A chemical-resistant apron worn over the lab coat is required for working with large quantities.
- No open-toe shoes are allowed.

c. Hand Protection

- Hand protection requirements for the use of solid pyrophoric chemicals outside an inerted glove box include wearing/donning the appropriate chemical resistant out gloves (Neoprene) and fire resistant (FR) inner gloves/liners.
- Gloves or glove liners composed of the tight weave, inherently flame resistant materials Kevlar[®], Nomex[®], Kerinel[®], or PBI[®], or a blend of those materials, of sufficient thickness to prevent or minimize burn injuries to the extent feasible. Gloves or glove liners meeting MIL-DTL-81188C are also acceptable.
- Acceptable glove liners include the followings:
 - ✓ Ansell Kevlar[®] Goldknit[®] Lightweight 70-200,
 - ✓ Hanz Extremity Wear Nomex[®] Utility 2257C and 2259C,
 - ✓ Other Kevlar[®] gloves with the fabric basis weight of a minimum of 7.7 ounces per square yard and if one layer of the material has a minimum of 35 mils in thickness, and
 - ✓ Other Nomex[®] gloves meeting the specifications for Hans Extremity Wear Nomex[®] Utility 2257G and 2259C.
- Laboratories must have these gloves available and use them for this specific research activity. This requirement may not be superseded by reference to a Safety Data Sheet (SDS).

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store pyrophoric chemicals under an inert atmosphere or under kerosene as appropriate. Avoid areas with heat/flames, oxidizers, and water resource. Containers carrying pyrophoric materials must be clearly labeled with the correct chemical name and hazard warning. Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Spill - Small

- Exert extreme caution due to potential spontaneous combustion
- Exert extreme caution due to ignition of flammable solvents or other materials.
- If anyone is exposed, or on fire, wash with copious amount of water, ideally in the lab shower.
- Call for co-worker to provide backup.
- Place a fire extinguisher nearby.
- Carefully remove nearby flammable materials.
- Powdered lime (calcium oxide, CaO) or dry sand should be used to completely smother and cover any spill that occurs.
- After complete quench, double bag spill residues for hazardous waste pickup.
- Call 911 for emergency assistance if necessary.

Spill - Large

- Exert extreme caution due to potential spontaneous combustion.
- Exert extreme caution due to potential ignition of flammable solvent or other materials.
- If anyone is exposed, or on fire, wash with copious amounts of water, ideally in the lab shower.
- Call 911 or EH&S at 951-827-5528 for emergency assistance.
- Evacuate the spill area
- Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering.
- Provide emergency personnel with technical advice on the chemical involved.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Small amounts of unused or unwanted pyrophoric materials must be destroyed by careful quenching of the residue. Transfer the materials to an appropriate reaction flask for hydrolysis and/or neutralization. Dilute significantly with an unreactive solvent such as heptane or toluene and place the flask in an ice water cooling bath. Slowly add isopropanol to quench pyrophoric materials. Upon completion, add Methanol as a more reactive quenching agent to ensure completion. Finally, add water dropwise to make sure there are no pockets of reactive materials. Dispose of as hazardous waste.

- Alternatively, reactive substances can be quenched by slowly adding the dilute solution to dry ice, then adding a mildly reactive quenching agent such as methanol.
- AVOID low boiling diluents such as ether and pentane that tend to condense water upon evaporation.
- Do not leave containers with residues of pyrophoric materials open to the atmosphere due to uncontrolled ignition.
- Affix an on-line hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with trimethylaluminum must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED WORK AREA

a. Eyewash

- Suitable facilities for quick drenching or flushing of the eyes should be within 10 seconds travel time for immediate emergency use. Bottle type eyewash stations are not acceptable.

b. Safety Shower

- A safety or drench shower should be available within 10 seconds travel time where pyrophoric chemical are used.

c. Fume Hood

- Gloves must be worn when handling pyrophoric chemicals. Nitrile gloves should be adequate for handling most of these in general laboratory settings, but they are combustible. Heavy gloves are required for work with large quantities. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

d. Fire Extinguisher

- A Class C dry chemical fire extinguisher must be available within 10 seconds travel time from where pyrophoric chemicals are used.
- Know the location of the nearest Class D fire extinguisher.
- A container of powdered lime (calcium oxide, CaO) or dry sand should be kept within arm's length when working with a pyrophoric material.

e. Batch Reactor with Rotary Pump

- Trimethylaluminum can only be used when it is connected to a well-pumped reactor. The reactor must be leak free.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using trimethylaluminum must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of trimethylaluminum and understand the hazards.

Lab workers using trimethylaluminum must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with trimethylaluminum described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 mL of this trimethylaluminum any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this trimethylaluminum with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using trimethylaluminum. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

ALD reactor

Working with trimethylaluminum is not allowed when alone in the Lab. Prior to starting the reaction, locate the powdered lime (calcium oxide, CaO) or dry sand, fire extinguisher, eyewash and safety shower.

In Zaera lab, trimethylaluminum are mainly used for atomic layer deposition of Aluminum oxide. Trimethylaluminum are volatile liquids stored in stainless steel containers with a ball valve, and it is connected to the reaction chamber (reactor) by Swagelok fittings. The reactor is pumped by a mechanical pump all the time. In our lab, trimethylaluminum can only be used when it is connected to a well-pumped reactor. The vapor pressure is used to introduce the chemical to the reactor. Do not try to get neat aluminum alkyl liquids out from the container.

1) Wear flame-resistant outer gloves, chemical-resistant inner gloves, flame-resistant lab coat, and safety goggles.

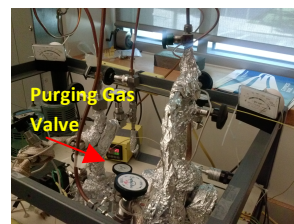
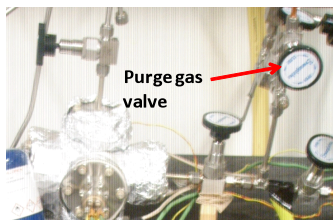
2). First, check the reactor for possible leaks. The base pressure in the reactor should around 5–10 mtorr, as read in the thermocouple gauge reader (see picture in the right). Fix the leaks before connect the trimethylaluminum to the reactor.



3). Connect trimethylaluminum to the reactor by Swagelok fittings. When handle trimethylaluminum, safety glass, lab coat, and gloves should be worn. The ball valve of the metal container should be always in off position (see picture in the right) when trimethylaluminum is not in use.

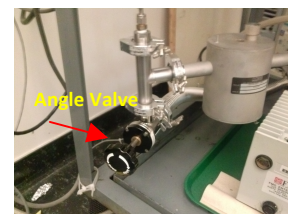
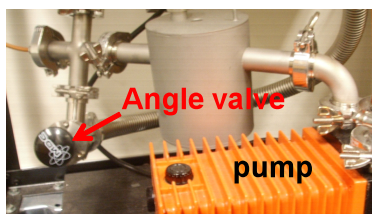


4). During the atomic layer deposition cycle, the reactor is first pumped down. Then open the ball valve to introduce trimethylaluminum into the reactor. The exposure time varies from a second to ten seconds. Right after trimethylaluminum exposure, shut off the ball valve. Then immediately introduce a purging gas (Argon or Nitrogen) into the reactor for about 1 minute. Adjust the purging gas valve to maintain the pressure in the reactor around 200–500 mtorr. Do not try to backfill the trimethylaluminum container with other gases.



5). The reactor body is normally heated to around 100 °C to minimize the water vapor inside. However, no part of the trimethylaluminum container should be subjected to a temperature higher than 125 F (52 °C).

a) In case of power failure during the exposure experiments, please follow the steps below. Shut off the ball valve of the trimethylaluminum immediately. Open the purging gas valve to leak purge gas into the reactor. Close the angle valve (see picture in the right) above the mechanical pump. When the power is back, make sure the mechanical pump is running. Then open the angle valve. At the same time, close the purging gas valve. The pressure in the reactor will drop.



b) The following paragraph describes the proper action to take if there is a fire.

If a fire comes out from the part between the ball valve and the container, immediately apply dry powder or fire extinguisher. Do not try to reach or remove the trimethylaluminum container. Call for help if the fire is large.

If a fire is inside the reactor, immediately close the ball valve. Close the angle valve. Introduce the purging gas into the reactor by opening the purging gas valve.

If a fire comes out from the Swagelok fittings, immediately close the ball valve. Apply dry powder or fire extinguisher. The vacuum of the reactor and connections need to be checked.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 10/01/2013, updated 03/15/2016

Trimethyl(methylcyclopentadienyl)platinum

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when trimethyl(methylcyclopentadienyl)platinum ($C_5H_4CH_3Pt(CH_3)_3$, CAS No. 94442-22-5) used in laboratory. Its purpose is not to have any accident or risk. Trimethyl(methylcyclopentadienyl)platinum is highly toxic by ingestion. Also it is harmful if inhaled, if swallowed, and if absorbed through skin. It may cause respiratory tract irritation, skin irritation, and eye irritation.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Toxic by Ingestion, Skin sensitizer

GHS Classification

- Acute toxicity, Oral (Category 1)
- Acute toxicity, Dermal (Category 2)
- Skin sensitization (Category 1)
- Acute aquatic toxicity (Category 1)

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with **trimethyl(methylcyclopentadienyl)platinum** must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for **trimethyl(methylcyclopentadienyl)platinum**.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using **trimethyl(methylcyclopentadienyl)platinum** must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of **trimethyl(methylcyclopentadienyl)platinum** and understand the hazards.

Lab workers using **trimethyl(methylcyclopentadienyl)platinum** must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with **trimethyl(methylcyclopentadienyl)platinum** described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale- of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);

- 4) employ < 0.5 g of this trimethyl(methylcyclopentadienyl)platinum in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this trimethyl(methylcyclopentadienyl)platinum with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using trimethyl(methylcyclopentadienyl)platinum. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Trimethyl(methylcyclopentadienyl)platinum Sample Preparation:

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggle.
2. Leak valve and 1'33" flange with sealed-off Pyrex glass end tube should be dried in the oven for 1 hour, cooled down to room temperature.
3. Take the leak valve, the flange, 1'33" copper gasket, and self-made spatula to Prof. Bocian's lab, follow the procedure of using the glovebox, transfer about 1 cm³ of this trimethyl(methylcyclopentadienyl)platinum to the flange, and close the leak valve inside the glovebox.
4. Care should be taken to fast mount the leak valve to chamber.
5. When the pressure in the preparation chamber is below 3x10⁻⁷ torr, open the leak valve, and wait until the pressure is down again.
6. Heat the glass tube to around 303 K, and keep the chamber, especially the parts on the delivery pass, at around 313 K.
7. Control the leak valve, and do the experiments.
8. After each experiment, heating the sample and chamber should be stopped to protect the o-rings around transfer rod.
9. After experiment, the silicon sample needs to be treated as solid hazardous waste. The glass tube needs to be cleaned with acetone and water, and the waste solution should be placed into the proper waste container.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name

 Signature

Approval Date: 03/01/2014, updated 03/01/2016

Ru Precursor

Tris(2,2,6,6-tetramethyl-3,5-heptanedionato)ruthenium

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when Ru precursor (STREM Chemicals, Inc.) ($\text{Ru}(\text{C}_{11}\text{H}_{19}\text{O}_2)_3$, CAS No. 38625-54-6) is used in laboratory. Its purpose is not to have any accident or risk. Ru precursor may cause skin, nose, and eye mild irritation. It may be harmful if inhaled or if swallowed.

Synonyms: Dipivaloymethane, Ruthenium complex

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: No Known OSHA hazard

GHS Classification
Not Available

Signs and Symptoms of Exposure

Not Available

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Handle material in an efficient fume hood or glove box in the absence of air. Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly sealed and labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Keep away from heat, air, and direct sunlight. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- *Small* – Small spills can be mixed with vermiculite, powdered limestone, or powdered sodium bicarbonate and swept up. If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.

- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with Ru precursor must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for Ru precursor.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using Ru precursor must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of Ru precursor and understand the hazards.

Lab workers using Ru precursor must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with Ru precursor described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;

- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 5 g of this Ru precursor in any given reaction (larger quantities REQUIRE the approval of PI or designee), and
- 5) discuss ALL issues or concerns regarding this Ru precursor with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using Ru precursor. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Ru precursor for Michelle UHV Chamber

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggle.
2. Add Ru precursor (1 mL) into the meta-glass adaptor container in the fume hood in room 135.
3. Connect the container to the leak valve of Michelle chamber.
4. Ru precursor is pumped by mechanical pump first and the leak valve later.
5. Heating is achieved by putting the container in a silicon-oil bath up to 100 °C
6. Open the leak valve to reach the desired vapor pressure.
7. Close the container valve.
8. Stop heating the silicon-oil bath.

SOP Reviewed and Approved by:

Francisco Zaera

 Print name

 Signature

Approval Date: 10/01/2015

Uridine 5'-monophosphate disodium salt STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when uridine 5'-monophosphate disodium salt (C₉H₁₁N₂Na₂O₉P, CAS No. N/A) is used in laboratory. Its purpose is not to have any accident or risk. Uridine 5'-monophosphate disodium salt may be harmful if inhaled, if swallowed and if absorbed through skin. It may cause skin, eye and respiratory tract irritation.

Synonyms: U 5'-P, UMP, Uridylic acid disodium salt

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: Not known

GHS Classification

N/A

Signs and Symptoms of Exposure

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with uridine 5'-monophosphate disodium salt must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.

- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for uridine 5'-monophosphate disodium salt.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using uridine 5'-monophosphate disodium salt must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of uridine 5'-monophosphate disodium salt and understand the hazards.

Lab workers using uridine 5'-monophosphate disodium salt must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenck line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with uridine 5'-monophosphate disodium salt described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 1 g of this uridine 5'-monophosphate disodium salt in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this uridine 5'-monophosphate disodium salt with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using uridine 5'-monophosphate disodium salt. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of chiral zeolite

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggles.
2. Take 0.08 g of Uridine 5'-monophosphate disodium salt in a 25 mL Teflon-lined autoclave, in the fume hood.
3. Add other reagents into the autoclave, and the reaction is conducted at 80 °C for 4 days.
4. After reaction, the filtrate needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera
Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014

Zinc oxide

STANDARD OPERATING PROCEDURE

Type of SOP: Process Hazardous Chemical Hazard Class

1. HAZARD OVERVIEW

This document describes the safety requirements that laboratory workers and supervisors must follow when zinc oxide (ZnO, CAS No. 1314-13-2) is used in laboratory. Its purpose is not to have any accident or risk. Zinc oxide causes eye and skin irritation. It is very toxic to aquatic life.

2. HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Please refer MSDS first always for physical and chemical properties before use.

OSHA Hazards: No known.

GHS Classification

Skin irritation (Category 3)

Eye irritation (Category 2B)

Acute aquatic toxicity (Category 1)

Signs and Symptoms of Exposure

Zinc oxide dust or fume can irritate the respiratory tract. Prolonged skin contact can produce a severe dermatitis called oxide pox. Exposure to high levels of dust or fume can cause metallic taste, marked thirst, coughing, fatigue, weakness, muscular pain, and nausea followed by fever and chills. Severe overexposure may result in bronchitis or pneumonia with a bluish tint to the skin. Prolonged or repeated exposure can cause Reversible liver enzyme abnormalities. Diarrhea

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

a. Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

b. Skin and Body Protection

Wear chemical resistant lab coat, long pants, and closed-toe shoes. These laboratory coats must be appropriately sized for the individual and be buttoned to their full length. Laboratory coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

Flame-resistant lab coat will be required, if working with pyrophoric chemicals.

c. Hand Protection

At a minimum, wear a nitrile chemical-resistant glove. Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

4. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified laboratory chemical fume hood with the sash at the certified position or lower. The hood flow alarm should be checked to be operating correctly prior to using the hood.

5. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

6. SPILL AND INCIDENT PROCEDURES

Chemical Spill - Dial 911 and EH&S 951-827-5528

Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Small – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear plastic bags, label, and arrange for chemical waste pick-up.
- Large– Dial 911 and EH&S at 951-827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill

area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. Notify supervisor and EH&S at 951-827-5528 immediately.

Medical Emergency - Dial 911 and EH&S 951-827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

7. DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using soap and water. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

8. WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

- Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
- Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating and disposing of it.
- Dispose of routinely generated chemical waste within 90 days.
- Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

9. PRIOR APPROVAL/REVIEW REQUIRED

All work with zinc oxide must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

- Documented specific training and specific training on the techniques and processes to be used.
- Read and understand the relevant Safety Data Sheet.
- Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

10. DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for zinc oxide.

11. SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

12. DETAILED PROTOCOL

All lab workers who will be using zinc oxide must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of zinc oxide and understand the hazards.

Lab workers using zinc oxide must demonstrate competence to the Principal Investigator or designee by being able to 1) identify the hazards and list any particularly hazardous handling techniques (use of a schlenk line, rotary evaporation, canula transfer, extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with zinc oxide described in this SOP. The researcher must also consult the PI or designated, experienced research coworker for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. PI approval must also be obtained for significant scale-up (PI defines scale) of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

- 1) not work alone;
- 2) be cognizant of all of the SDS and safety information presented in this document;
- 3) follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
- 4) employ < 10 g of this zinc oxide in any given reaction (larger quantities REQUIRE the approval of PI or designee), and

- 5) discuss ALL issues or concerns regarding this zinc oxide with the PI prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator or Lab Supervisor and others who might be using zinc oxide. Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

Preparation of chiral zeolite

1. Wear a nitrile chemical-resistant glove, flame-resistant lab coat, and safety goggle.
2. Take zinc oxide (0.05 g) in a 25 mL Teflon-lined autoclave in the fume hood.
3. Add other reagents into the autoclave, and the reaction is conducted at 80 °C for 4 days.
4. After reaction, the filtrate needs to be treated as hazardous waste.
5. Washing and cleaning solvents also need to be treated as hazardous waste.

SOP Reviewed and Approved by:

Francisco Zaera

Print name

Signature

Approval Date: 02/01/2013, updated 03/01/2014
